# Infrastructure Master Plan 2020
# 2020/2021 – 2050/2051

## Volume 8:
## Middle uThukela System and uMhlathuze System


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# UMGENI WATER

# INFRASTRUCTURE MASTER PLAN 2020

## 2020/2021 – 2050/2051

## JUNE 2020

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# PREFACE

This Infrastructure Master Plan 2020 describes:

- Umgeni Water's infrastructure plans for the financial period 2020/2021 – 2050/2051, and
- Infrastructure master plans for other areas outside of Umgeni Water's Operating Area but within KwaZulu-Natal.

It is a comprehensive technical report that provides information on current infrastructure and on future infrastructure development plans. This report replaces the last comprehensive Infrastructure Master Plan that was compiled in 2019 and which only pertained to the Umgeni Water Operational area.

The report is divided into **ten** volumes as per the organogram below.

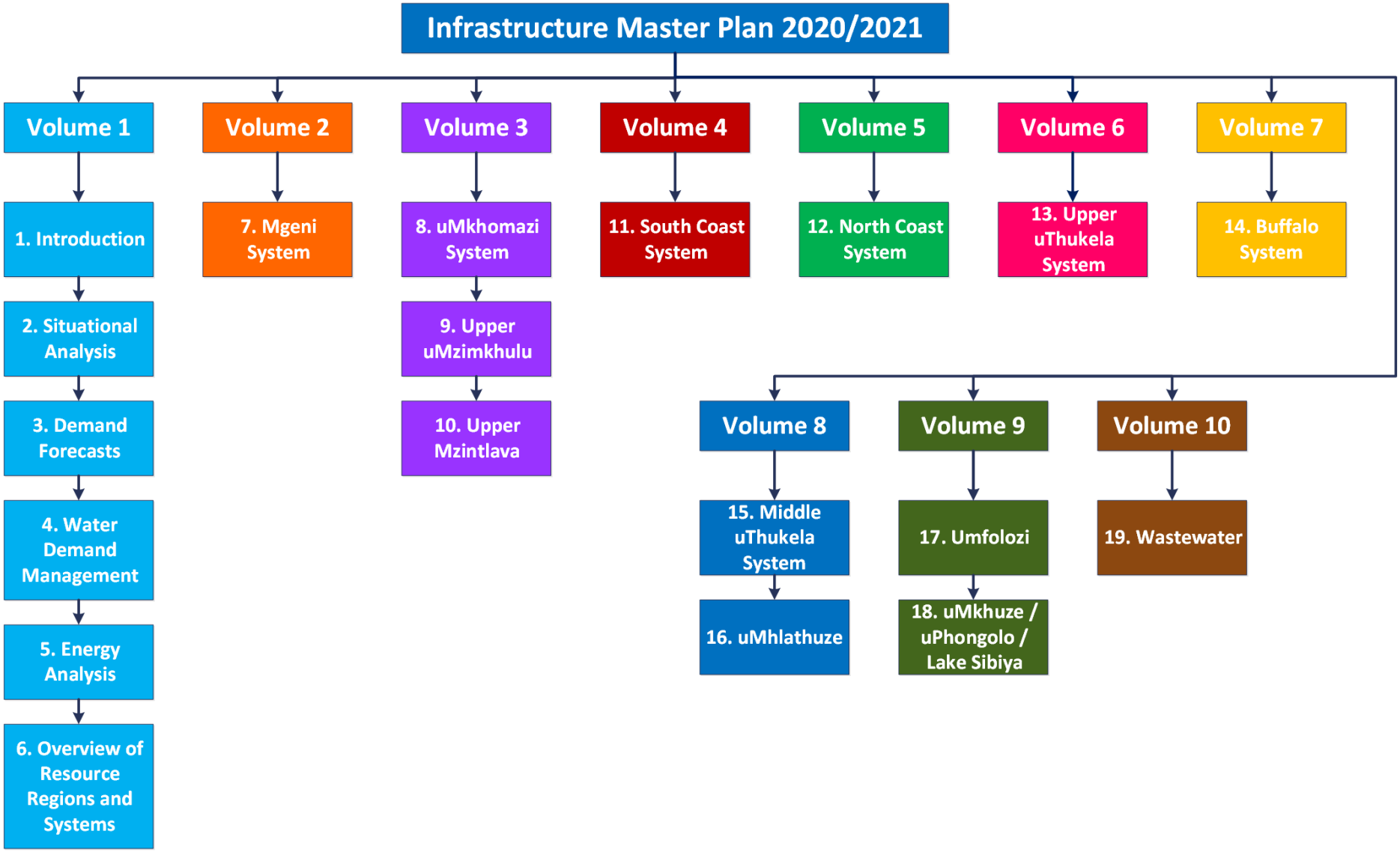
**Volume 1** includes the following sections and a description of each is provided below:

- **Section 2** describes the most recent changes and trends within the primary environmental dictates that influence development plans within the province.
- **Section 3** relates only to the Umgeni Water Operational Areas and provides a review of historic water sales against past projections, as well as Umgeni Water's most recent water demand projections, compiled at the end of 2019.
- **Section 4** describes Water Demand Management initiatives that are being undertaken by the utility and the status of Water Demand Management Issues in KwaZulul-Natal.
- **Section 5**, which also relates to Umgeni Water's Operational Area, contains a high level review of the energy consumption used to produce the water volumes analysed in **Section 3**.
- **Section 6** provides an overview of the water resource regions and systems supplied within these regions.

The next eight volumes describe the current water resource situation and water supply infrastructure of the various systems in KwaZulu-Natal, including:

| | | |
|---|---|---|
| • **Volume 2** | **Section 7** | Mgeni System. |
| • **Volume 3** | **Section 8** | uMkhomazi System |
| | **Section 9** | uMzimkhulu System |
| | **Section 10** | Mzintlava System |
| • **Volume 4**- | **Section 11** | South Coast System |
| • **Volume 5** | **Section 12** | North Coast System |
| • **Volume 6** | **Section 13** | Upper uThukela System |
| • **Volume 7** | **Section 14** | Buffalo System |
| • **Volume 8** | **Section 15** | Middle uThukela System |
| | **Section 16** | Mhlathuze System |
| • **Volume 9** | **Section 17** | Umfolozi System |
| | **Section 18** | uMkhuze / uPhongolo / Lake Sibiya System |

**Volume 10, Section 19** describes the wastewater works currently operated by Umgeni Water (shown in pale brown in the adjacent figure) and provides plans for development of additional wastewater treatment facilities. The status of wastewater treatment in WSA's that are not supplied by Umgeni Water are also described in this section.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2. Situational Analysis
3. Demand Forecasts
4. Water Demand Management
5. Energy Analysis
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19. Wastewater

It is important to note that information presented in this report is in a summarised form and it is recommended that the reader refer to relevant planning reports if more detail is sought. Since the primary focus of this Infrastructure Master Plan is on bulk supply networks, the water resource infrastructure development plans are not discussed at length. The Department of Water and Sanitation (DWS), as the responsible authority, has undertaken the regional water resource development investigations. All of these investigations have been conducted in close collaboration with Umgeni Water and other major stakeholders in order to ensure that integrated planning occurs. Details on these projects can be obtained directly from DWS, Directorate: Options Analysis (East).

The Infrastructure Master Plan is a dynamic and evolving document. Outputs from current planning studies, and comments received on this document will therefore be taken into account in the preparation of the next update.

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| | |
|---|---|
| AADD | Annual Average Daily Demand |
| AC | Asbestos Cement |
| ADWF | Average Dry Weather Flow |
| API | Antecedent Precipitation Index |
| AsgiSA | Accelerated and Shared Growth Initiative of South Africa |
| AVGF | Autonomous Valveless Gravity Filter |
| BID | Background Information Document |
| BPT | Break Pressure Tank |
| BWL | Bottom Water Level |
| BWSP | Bulk Water Services Provider |
| BWSS | Bulk Water Supply Scheme |
| CAPEX | Capital Expenditure |
| CMA | Catchment Management Agency |
| CoGTA | Department of Co-operative Governance and Traditional Affairs |
| CWSS | Community Water Supply and Sanitation project |
| DAEA | Department of Agriculture and Environmental Affairs |
| DEA | Department of Environmental Affairs |
| DFA | Development Facilitation Act (65 of 1995) |
| DM | District Municipality |
| DMA | District Management Area |
| DRDLR | Department of Rural Development and Land Reform |
| DWA | Department of Water Affairs |
| DWS | Department of Water and Sanitation |
| DWAF | Department of Water Affairs and Forestry |
| EFR | Estuarine Flow Requirements |
| EIA | Environmental Impact Assessment |
| EKZN Wildlife | Ezemvelo KZN Wildlife |
| EMP | Environmental Management Plan |
| EWS | eThekwini Water Services |
| EXCO | Executive Committee |
| FC | Fibre Cement |
| FL | Floor level |
| FSL | Full Supply level |
| GCM | General Circulation Model |
| GDP | Gross Domestic Product |
| GDPR | Gross Domestic Product of Region |
| GVA | Gross Value Added |
| HDI | Human Development Index |
| IDP | Integrated Development Plan |
| IFR | In-stream Flow Requirements |

| | |
|---|---|
| IMP | Infrastructure Master Plan |
| IRP | Integrated Resource Plan |
| ISP | Internal Strategic Perspective |
| IWRM | Integrated Water Resources Management |
| KZN | KwaZulu-Natal |
| LM | Local Municipality |
| LUMS | Land Use Management System |
| MA | Moving Average |
| MAP | Mean Annual Precipitation |
| MAR | Mean Annual Runoff |
| MBR | Membrane Bioreactor |
| MMTS | Mooi-Mgeni Transfer Scheme |
| MMTS-1 | Mooi-Mgeni Transfer Scheme Phase 1 |
| MMTS-2 | Mooi-Mgeni Transfer Scheme Phase 2 |
| mPVC | Modified Polyvinyl Chloride |
| MTEF | Medium-Term Expenditure Framework |
| MTSF | Medium-Term Strategic Framework |
| MWP | Mkomazi Water Project |
| MWP-1 | Mkomazi Water Project Phase 1 |
| NCP-1 | North Coast Pipeline I |
| NCP-2 | North Coast Pipeline II |
| NCSS | North Coast Supply System |
| NGS | Natal Group Sandstone |
| NPV | Net Present Value |
| NSDP | National Spatial Development Perspective |
| NWSP | National Water Sector Plan |
| OPEX | Operating Expenditure |
| p.a. | Per annum |
| PES | Present Ecological Status |
| PEST | Political, Economical, Sociological and Technological |
| PGDS | Provincial Growth and Development Strategy |
| PPDC | Provincial Planning and Development Commission (KZN's) |
| PSEDS | Provincial Spatial Economic Development Strategy |
| PWSP | Provincial Water Sector Plan |
| RCC | Roller Compacted Concrete |
| RDP | Reconstruction and Development Programme |
| RO | Reverse Osmosis |
| ROD | Record of Decision |
| RQO | Resource Quality Objective |
| SCA | South Coast Augmentation |
| SCP | South Coast Pipeline |
| SCP-1 | South Coast Pipeline Phase 1 |

| | |
|---|---|
| SCP-2a | South Coast Pipeline Phase 2a |
| SCP-2b | South Coast Pipeline Phase 2b |
| SDF | Spatial Development Framework |
| SHR | St Helen's Rock (near Port Shepstone) |
| STEEPLE | Social/demographic, Technological, Economic, Environmental (Natural), Political, Legal and Ethical |
| SWRO | Seawater Reverse Osmosis |
| TEC | Target Ecological Category |
| TBM | Tunnel Boring Machine |
| TLC | Transitional Local Council |
| TWL | Top Water Level |
| uPVC | Unplasticised Polyvinyl Chloride |
| UW | Umgeni Water |
| WA | Western Aqueduct |
| WC | Water Conservation |
| WDM | Water Demand Management |
| WMA | Water Management Area |
| WRC | Water Research Commission |
| WSA | Water Services Authority |
| WSDP | Water Services Development Plan |
| WSNIS | Water Services National Information System |
| WSP | Water Services Provider |
| WTP | Water Treatment Plant |
| WWW | Wastewater Works |

Spellings of toponyms have been obtained from the Department of Arts and Culture (DAC). DAC provides the official spelling of place names and the spellings, together with the relevant gazette numbers, can be accessed at http://www.dac.gov.za/content/toponymic-guidelines-map-and-other-editors.

When using any part of this report as a reference, please cite as follows:

Umgeni Water, 2020. *Umgeni Water Infrastructure Master Plan 2020/2021 – 2050/51, Vol 1 - 10*. Prepared by Planning Services, June 2020.

# LIST OF UNITS

| | | |
|---|---|---|
| **Length/Distance:** | mm | millimetre |
| | m | metre |
| | km | kilometre |
| **Area:** | $m^2$ | square metres |
| | ha | hectare |
| | $km^2$ | square kilometres |
| **Level/Altitude:** | mASL | metres above sea-level |
| **Time:** | s | second |
| | min | minute |
| | hr | hour |
| **Volume:** | $m^3$ | cubic metres |
| | Mℓ | megalitre |
| | million $m^3$ | million cubic metres |
| | mcm | million cubic metres |
| **Water Use/Consumption/Treatment/Yield:** | ℓ/c/day | litre per capita per day |
| | kℓ/day | kilolitre per day |
| | Mℓ/day | megalitre per day |
| | million $m^3$/annum | million cubic metres per annum |
| | kg/hr | kilograms per hour |
| **Flow velocity/speed:** | m/s | metres per second |
| **Flow:** | $m^3$/s | cubic metres per second |
| | ℓ/hr | litres per hour |
| | $m^3$/hr | cubic metres per hour |

# 15. MIDDLE UTHUKELA SYSTEM

## 15.1 Synopsis of the Middle uThukela System

The Middle uThukela region consists of the uThukela catchment between the Buffalo-uThukela confluence and the Woshi-uThukela confluence. The uThukela River meanders in a south-easterly direction, with the Mvoti Local Municipality (uMzinyathi WSA) located predominantly south of the uThukela River and the Nkandla Local Municipality (King Cetshwayo WSA) occupying the area north of the uThukela River (**Figure 15.1**).

Whilst Nkandla Local Municipality has the largest area in the Middle uThukela Region, the town of Nkandla is located approximately 1.4 km east of the Middle uThukela-uMhlathuze watershed. The settlements of Qudeni and Kranskop, however, are located on the Middle uThukela watershed: Qudeni on the Buffalo-Middle uThukela watershed and Kranskop on the Mvoti-Middle uThukela watershed. Settlements occurring in the Middle uThukela region include Dlolwana, Jameson's Drift and The Ranch.

The Middledrift Pumping Scheme, an inter-basin transfer scheme that transfers water from the uThukela River to Lake Phobane to provide an assured supply of water to Richard's Bay, the largest port in Africa, is located in the Middle uThukela Region. This scheme is discussed in **Section 16**.

The WTPs located in the Middle uThukela Region are summarised in **Table 15.1**.

**Table 15.1 WTPs located in the Middle uThukela Region (UAP Phase 3 2020: GIS Dataset).**

| Scheme | Water Treatment Plant | Capacity (Mℓ/day) | Site |
|---|---|---|---|
| Vutshini-Nkandla | Mfongosi WTP | Unknown | Manzawayo-Mfongosi confluence. |
| Vutshini-Nkandla | Khombe Hospital WTP | 1 | Upstream of tributaries flowing into the Vutshini River. |
| Makabeleni | Makhabeleni WTP | 4 | uThukela River near Jameson's Drift. |
| Middledrift | Middledrift WTP | 10 | East of Ntolwane, on the banks of the Mkalazi, which flows westwards into the Nsuze |
| Ngcebo Water Supply Scheme | Ngcebo WTP | 4 | uThukela River near Middle uThukela-Lower uThukela watershed. |

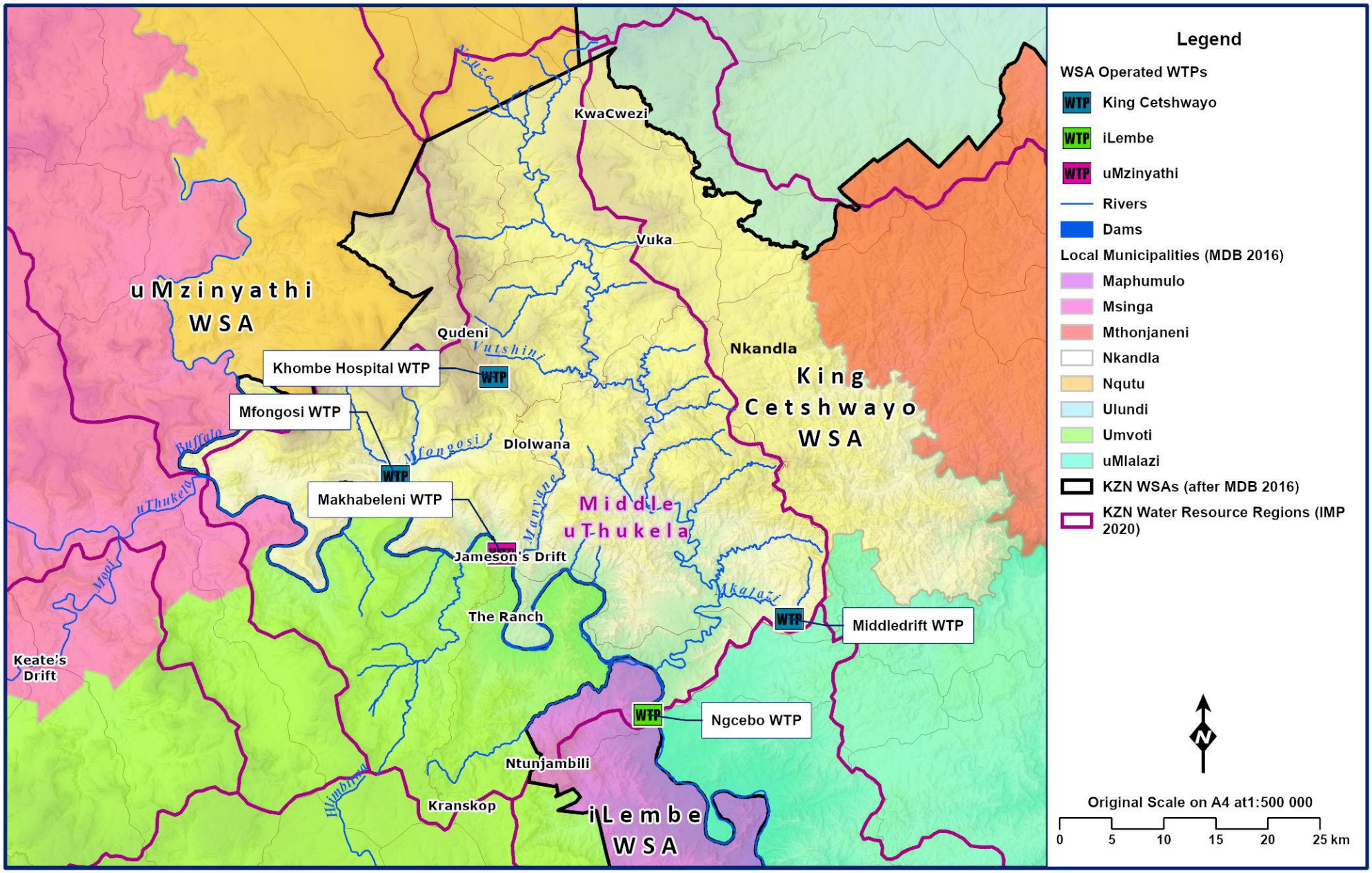


**Figure 15.1 General layout of the Middle uThukela Region.**

The water supply schemes in this region are predominantly supplied from the run-off-river abstraction infrastructure:

- Vutshini Nkandla Water Supply scheme – this scheme is supplied mainly from a run-of-river abstraction from the Vutshini Stream and the Vove Dam in the Buffalo System (yield of 0.33 Mℓ/day) and the Mhlathuze River in the Mhlathuze System (yield of 1.34 Mℓ/day).
- The Makabeleni Water Supply scheme is supplied from the uThukela River (yield of 1 Mℓ/day) near Jameson's Drift.
- Middledrift Water Supply scheme – this scheme is supplied from the uThukela Transfer scheme abstraction works downstream of the uThukela-Nsuze confluence with the water feeding various villages in the Middledrift Supply Area.
- Ngcebo Water Supply scheme - raw water is abstracted at the Middledrift Abstraction works and is supplied via a raw water pipeline, across the river, to the Ngcebo WTP. From the treatment works, a bulk potable water rising main supplies a few reticulation reservoirs.

# 15.2 Water Resources of the Middle uThukela System

## 15.2.1 Description of the Middle uThukela System Water Resource Regions

### (a) Middle Thukela Region

#### (i) Overview

As mentioned in **Section 15.1**. the uThukela River meanders in a south-easterly direction from the Buffalo-uThukela confluence, which is located approximately 1.9 km west of the Ntshongweni Hill (Trig Beacon 388 at an elevation of 1032.8 mASL (2830DA 1 : 50 000 Topographic Map 2013). Tributaries flowing from the north into the uThukela River include the:

- Mfongosi. The headwaters of the Mfongosi are located approximately 3.9 km north-west of Dlolwana and south-east of the Nkonyane Hill (Trig Beacon 413) in the Qudeni Nature Reserve. The Mfongosi flows in a south-westerly direction into the uThukela River (2830DB 1 : 50 000 Topographic Map 2013).

  The Mfongosi WTP is positioned at the Manzawayo-Mfongosi confluence, approximately 2 km upstream of the Mfongosi-uThukela confluence (UAP Phase 3 2020: GIS dataset and 2830 DB 1 : 50 000 Topographic Map 2013).

- Manyane. The Manyane headwaters are located north-east of Dlolwana (2830DB 1 : 50 000 Topographic Map 2013) and flows in a southerly direction, passed the Isilokomane Mountain on the east and into the uThukela River at Jameson's Drift (2830DD 1 : 50 000 Topographic Map 2013).

- Nsuze. The headwaters of the Nsuze River start on the Siphezi Hill (Trig Beacon 331 at 1547.6 mASL) (2830DB 1 : 50 000 Topographic Map 2013). The Nsuze River meanders in a southerly direction with tributaries including the Maxhuma, Mathole, Vutshini and Mkalazi, before it flows into the uThukela River approximately 2.2 km downstream of the Shu Shu

Warm Baths (2831CC 1 : 50 000 Topographic Map 2013). The Middledrift Pumping Scheme is approximately 1.1 km downstream of the uThukela-Nsuze confluence.

The headwaters of the Vutshini is located approximately 2.9 km south-east of Qudeni as the crow flies. The Vutshini flows in a south-easterly direction into the Nsuze River. The Khombe Hospital WTP, in the settlement of Spinnies, is located upstream of this tributary (2830DB 1 : 50 000 Topographic Map 2013).

The Middledrift WTP as east of Ntolwane, on the banks of the Mkalazi River, which flows westwards into the Nsuze River (2831CC 1 : 50 000 Topographic Map 2013). The capacity of the WTP is 10 Ml/day (UAP Phase 3 2020: GIS Dataset).

The proposed Nsuze WTP is on the Nsuze River, south of the Sangeni settlement and between the Maxhuma-Nsuze and Mathole-Nsuze confluences (UAP Phase 3 2020: GIS dataset and 2830BD 1 : 50 000 Topographic Map 2013). The UAP Phase 3 further identified the capacity of the proposed Nsuze WTP as 20 Mℓ/day (2020: GIS dataset).

Tributaries flowing into the uThukela River from the south include the Vamvule and the Ngcaza.

The Middle uThukela Region comprises of tertiary catchment V40 and quaternary catchment V60K. The most dominant land cover (**Figure 15.2**) category in this region is forestland and grassland occupying 50% and 27% of the entire region respectively.

### (ii) Surface Water

The hydrological characteristics for this region are summarised in **Table 15.2**.

**Table 15.2 Middle Thukela Region hydrological characteristics ((WR90, WR2012: Thukela Quat Info WMA 7 7Jul2015 spreadsheet)**

| Region | River (Catchment) | Area ($km^2$) | Annual Average | | | |
|---|---|---|---|---|---|---|
| | | | Evaporation (mm) | Rainfall (mm) | Natural Runoff (million $m^3$/annum) | Natural Runoff (mm) |
| Middle Thukela | Thukela River (V40) | 1754 | 1415 | 817 | 159.2 | 90.8 |
| | Thukela River (V60K) | 228 | 1400 | 691 | 13.0 | 57.0 |
| | **Total** | **1982** | | | | |

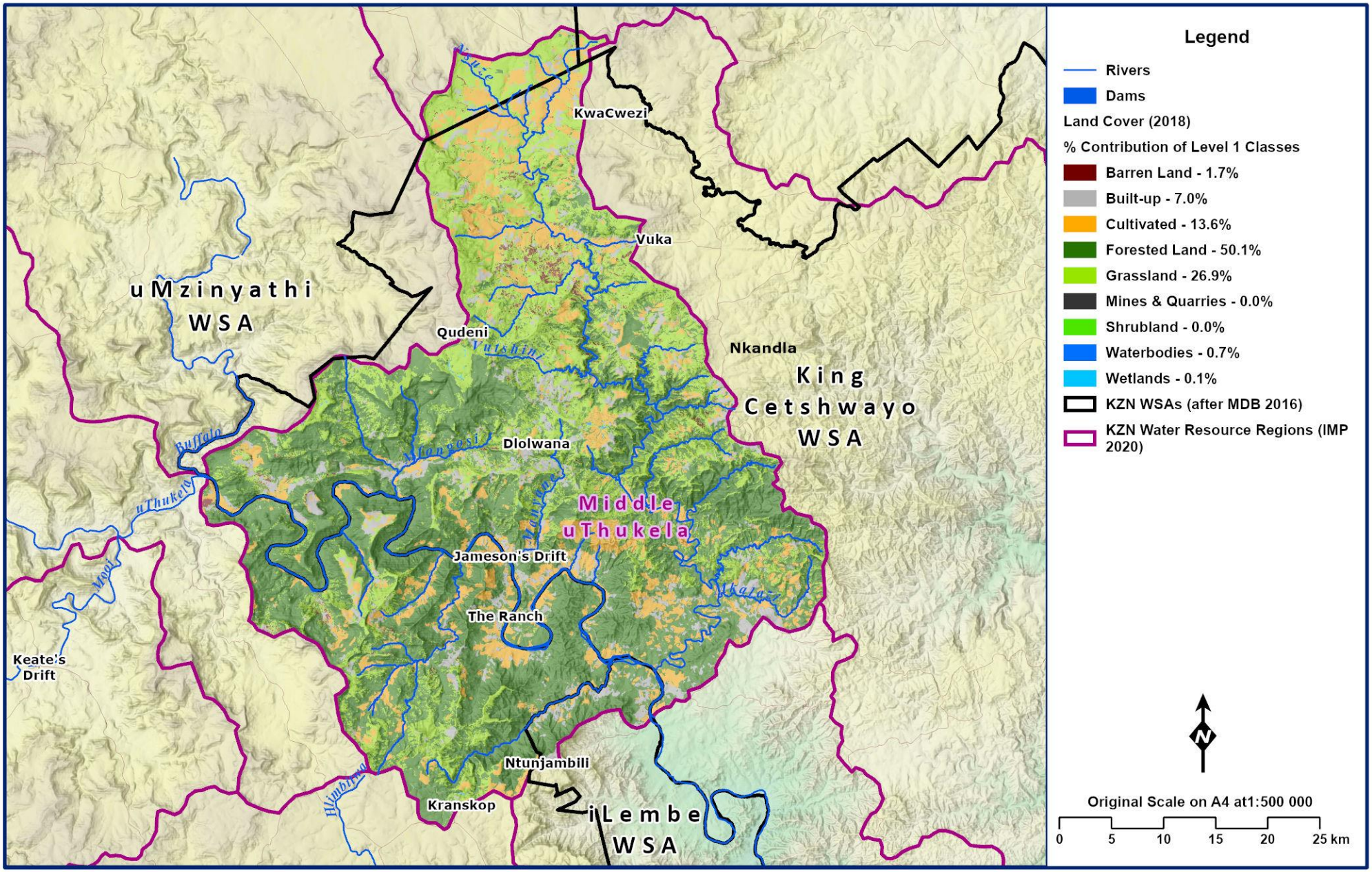


**Figure 15.2 Middle uThukela land cover (DEA and GTI 2018, KZN DoT 2017, MDB 2016, Umgeni Water 2020).**

## (iii) Groundwater

The Middle uThukela region is located in two hydrogeological regions, the Kwazulu-Natal Coastal Foreland and North Eastern Middleveld (DWAF 2008) (**Figure 15.3**).

### • Hydrogeological Units

Basement rocks are exposed mainly in the northern parts of the area, comprising granite-gneiss, schists and amphibolites.

The outcrop of Dwyka Group Tillite is prevalent around Kranskop Qudeni. Sediments of the Ecca Group are found in the eastern part of the area, with rocks of the Vryheid Formation underlying much of the area. These rocks mainly comprise sandstones and are relatively resistant to erosion, resulting in relatively narrow and deeply incised river channels.

All the above sedimentary strata have been extensively intruded by dykes and sills of dolerite. These features play an important role in the geohydrology of the area, and significantly enhance the water-bearing properties of aquifers in the area.

The Natal Metamorphic Province includes rocks of some 1000 Ma, but their extent is limited to the south-eastern part of the catchment around Kranskop. The extent of the Natal Group is also limited to the area east of Kranskop.

### • Geohydrology

The study area is mostly underlain by the Karoo Supergroup and is either sub-horizontal or has a very gentle inland dip to the west, wherein the structure comprises numerous south-easterly tilted fault blocks. These fault blocks play an important role in groundwater flow. Aquifers within the study area include:

- Weathered and fractured hard rock aquifer systems.
- Primary aquifers that are confined to a narrow strip along the middle reaches of the uThukela, Sundays and Buffalo Rivers.

### • Groundwater Potential

Groundwater yields from 'hard-rock' boreholes in the area are generally low and in the range 0.1 to 0.6 ℓ/s, although significantly higher yields (3 ℓ/s) can be obtained in hydrogeologically favourable situations, such as fracturing and intrusive Karoo dolerite contact zones. Contacts between different lithologies were also seen to be important drilling targets. There is little difference in yield amoung the various geological formations. Higher borehole yields can be obtained in some localities. Juxtaposition of sandstone horizons to dolerite, major structural features such as faults and fractures and more competent Natal Group quartzites and sandstones have produced borehole yields in excess of 2 ℓ/s. The likelihood of obtaining yields in excess of 2 ℓ/s, however, is less than 30%, while few boreholes yield more than 3 ℓ/s. Groundwater recharge over the area varies from 1 to 5 % of the mean annual precipitation (MAP), with an average of about 3 percent of the MAP.

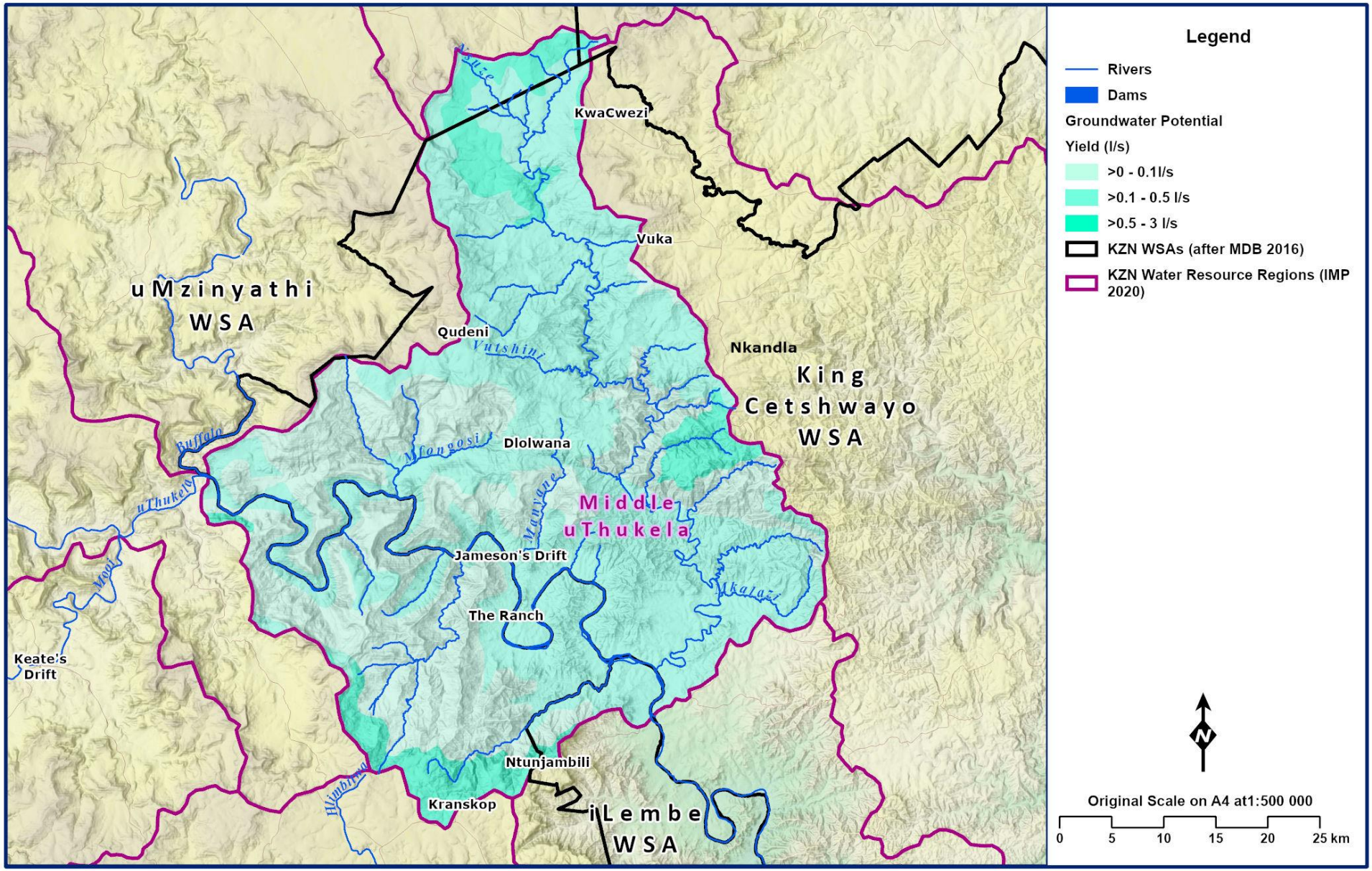


**Figure 15.3** **Groundwater potential in the Middle Thukela Region (KZN DoT 2017, MDB 2016, Umgeni Water 2020, WR2012).**

### (iv) Water Quality

- **Surface Water**

There are no known major water quality problems in the Vutshini Water Supply Scheme area. It is, however, likely that the quality of the Vutshini River is significantly affected during periods of low flow due to the land use activities upstream and soil erosion (Department of Water Affairs Vutshini All Town Study, 2011, Page23).

- **Groundwater**

Groundwater quality in the area is generally good, with the best quality groundwater found in the higher rainfall portions, and the poorest quality in the lower rainfall areas towards the east, groundwater quality deteriorates in the direction of flow and assumes a more dominant N-Cl character. The total dissolved solid (TDS) content of the groundwater is generally in the range 50 to 200 mg/l, but this can rise to considerably more than 420 mg/l in the lower rainfall portions. Good quality groundwater is found in the mountain headwaters, with quality deteriorating in the direction of flow. Poorer quality groundwater is found in the lower reaches of the Upper uThukela, Bushmans and Mooi Catchments, probably reflecting the influence of the argillaceous sediments in this part of the study area. Instances of elevated fluoride were reported for the western part of the catchment.

## 15.2.2 Reserve

The Middle uThukela Region was not part of the DWS 2016 study to determine the Ecological Reserve and the Resource Quality Objectives. Water for the Ecological Reserve is water that must remain in the river and may not be abstracted. This results in a reduction in yield available for supply. The Reserve Classification Study of uThukela WMA was commissioned by DWS in February 2020 and the progress will be reported in the next IMP update. This study is critical to ensure that water resources in the region are able to sustain the intended level of use.

The determination of the water resource classes of the water resources in the uThukela WMA will ensure that the desired condition of the water resources, and conversely, the degree to which they can be utilised is maintained and adequately managed within the economic, social and ecological goals of the water users.

The DWAF 2004 “Thukela Reserve Determination Study” was an informant to the uThukela ISP, which reported that:

- The uThukela Reserve water resource analysis assumed that the Spioenkop, Ntshingwayo and Wagendrift dams will all contribute to the users and the Reserve in the Middle to Lower uThukela areas. This conjunctive use of these three dams results in large theoretical surpluses in the Lower uThukela.

## 15.2.3 Existing Water Resource Infrastructure and Yields

The Vutshini and Nkandla supply areas were combined into a single supply area so as to shift the supply area boundary eastwards, incorporating the Nsuze River as a sustainable supply source. The water supply area covers the north-western section of the Nkandla Local Municipality, within King Cetshwayo District Municipality (UThungulu DM, 2015, Page 3).

The Vutshini-Nkandla Regional Scheme is the main water supply scheme in this region and is described below:

- The Nkandla Water Supply Scheme area straddles the upper Mhlatuze River (i.e. quaternary catchment W12A) and the Nsuze River catchments (i.e. quaternary catchments V40C & D).

- The Vutshini Water Supply Scheme utilises the uThukela River as its main source (1 Mℓ/day) and the Vutshini River, which is a tributary of the Nsuze River, as an alternate source. The Vutshini Water Supply Scheme comprises of two WTPs. Only one plant falls within this region, namely, the Vutshini WTP at the Vutshini Village. The WTP supplies the village and the surrounding villages up to Msobotsheni in the north-east and Ntingwe in the south (Department of Water Affairs, 2011, page 17). Ntingwe Dam (**Figure 15.4** and **Table 15.4**) supplies raw water for both irrigation and water supply purposes to the Ntingwe rural community.

  During low flow periods the maximum abstraction over a 3-month period, at the Vutshini WTP, is approximately 0.03 million $m^3$. This amount is not sufficient to meet the 3-month peak summer demand of 0.39 million $m^3$ (Department of Water Affairs All Town study, 2011, Page 22)

Dams found in this region include the Ntingwe Masonry and Ntingwe dams which are being used as irrigation dams. During dry periods there is insufficient water in the Lower uThukela River and releases from upstream dams is needed.

A dam on the Nsuze River is recommended to supply the future demand of the Vutshini-Nkandla regional scheme. Preliminary hydrological investigations indicate that a dam impounding 31 million $m^3$ will have a sufficient yield of 19 Mℓ/day for the scheme (UAP Phase 3, 2019).

The other scheme in this region is the Kranskop Water Supply Scheme which is currently supplied by groundwater abstraction. The nearest river is the Mandleni River which is part of the uThukela River.

Other small treatment works exist in this area but are not reported on here as they don't constiture bulk schemes. These are either supplied from run-of-river abstractions or boreholes (Department of Water Affairs All Town study, 2011, Page 22).

The water supply area showing the respective sources of supply is presented in **Table 15.3**.

**Table 15.3 Supply Area and their respective water sources (Umgeni Water, 2019: 17)**

| Scheme supply Area | Local Municipality | Source |
|---|---|---|
| Vutshini-Nkandla | Nkandla | Nsuze River, uThukela River |

## 15.2.4 Operating Rules

The Ntingwe Dam (**Figure 15.4** and **Table 15.4**) is used solely to support irrigation needs. As a result, there are no operating rules presented for Ntingwe dam.

**Figure 15.4 Ntingwe Dam (MBB Consulting Engineers 2020: website).**

**Table 15.4 Characteristics of Ntingwe Dam.**

| | |
|---|---|
| **Catchment Details** | |
| **Incremental Catchment Area:** | 1.03 $km^2$ [a] |
| **Total Catchment Area:** | 5 $km^2$ [a] |
| **Mean Annual Precipitation:** | 810 mm [b] |
| **Mean Annual Runoff:** | 0.21 million $m^3$ [b] |
| **Annual Evaporation:** | 1400 mm [b] |
| **Dam Characteristics** | |
| **Gauge Plate Zero:** | 943.5 mASL [e] |
| **Full Supply Level:** | 960 mASL [e] |
| **Net Full Supply Capacity:** | 0.4 million $m^3$ [c] |
| **Spillway Height:** | 16.5 m [c] |
| **Dead Storage:** | N/A |
| **Total Capacity:** | 0.4 million $m^3$ [c] |
| **Original Measured Dam Capacity:** | 0.4 million $m^3$ [c] |
| **Surface Area of Dam at Full Supply Level:** | 0.07 $km^2$ [c] |
| **Dam Type:** | Earth fill [c] |
| **Material Content of Dam Wall:** | Earth fill [c] |
| **Crest Length:** | Crest length: 134 m [c]<br>Spillway Section: 24 m [d]<br>Non-Spillway Section: 110 m [d] |
| **Type of Spillway:** | Side Channel Spillway [c] |
| **Capacity of Spillway:** | N/A |
| **Date of Completion:** | 2001 [c] |
| **Date of Last Area Capacity Survey:** | 2009 [c] |
| **Date of Next Area Capacity Survey:** | N/A |

[a] Catchment delineation using 20m DEM and spatial analyst.
[b] WR2012
[c] DWS List of Registered Dams Database (April 2019).
[d] Measured on Google Earth.
[e] 0.5m Contours

# 15.3 Supply Systems

## 15.3.1 Description of the Middle uThukela System

The Middle uThukela System includes supply to two major areas including those south of the uThukela River in uMzinyathi DM and those north of the uThukela River in King Cetshwayo DM. Supply to the King Cetshwayo areas is predominantly from water abstracted at Middledrift and as a result this is reported on the Mhlathuze System **Section 16**. Supply to the uMzinyathi Area is described below.

### (a) Makhabeleni WTP and Supply System

Makhabeleni WTP is located in Makahabeleni (Jameson's Drift) along the uThukela River in the uMzinyathi District Municipality.

Makhabeleni WTP obtains its raw water from the uThukela River. The raw water is treated at the treatment plant and distributed to various reservoirs in different parts of Makhabeleni.

The WTP was upgraded from 2 Mℓ/day to 4 Mℓ/day towards the end of 2017 and five phases of the distribution network were completed towards the end of 2018. A portion of the sixth phase of the distribution system was also completed in 2018.

The spatial layout of the completed phases 1 to 5, a portion of phase 6 and the planned phases 7 and 8 are shown in **Figure 15.5** and the schematic is illustrated in **Figure 15.6**.

The characteristics of the Makhabeleni WTP are shown in **Table 15.5**. The pump details, reservoir details and pipeline details are listed in **Table 15.6**, **Table 15.7** and **Table 15.8** respectively.

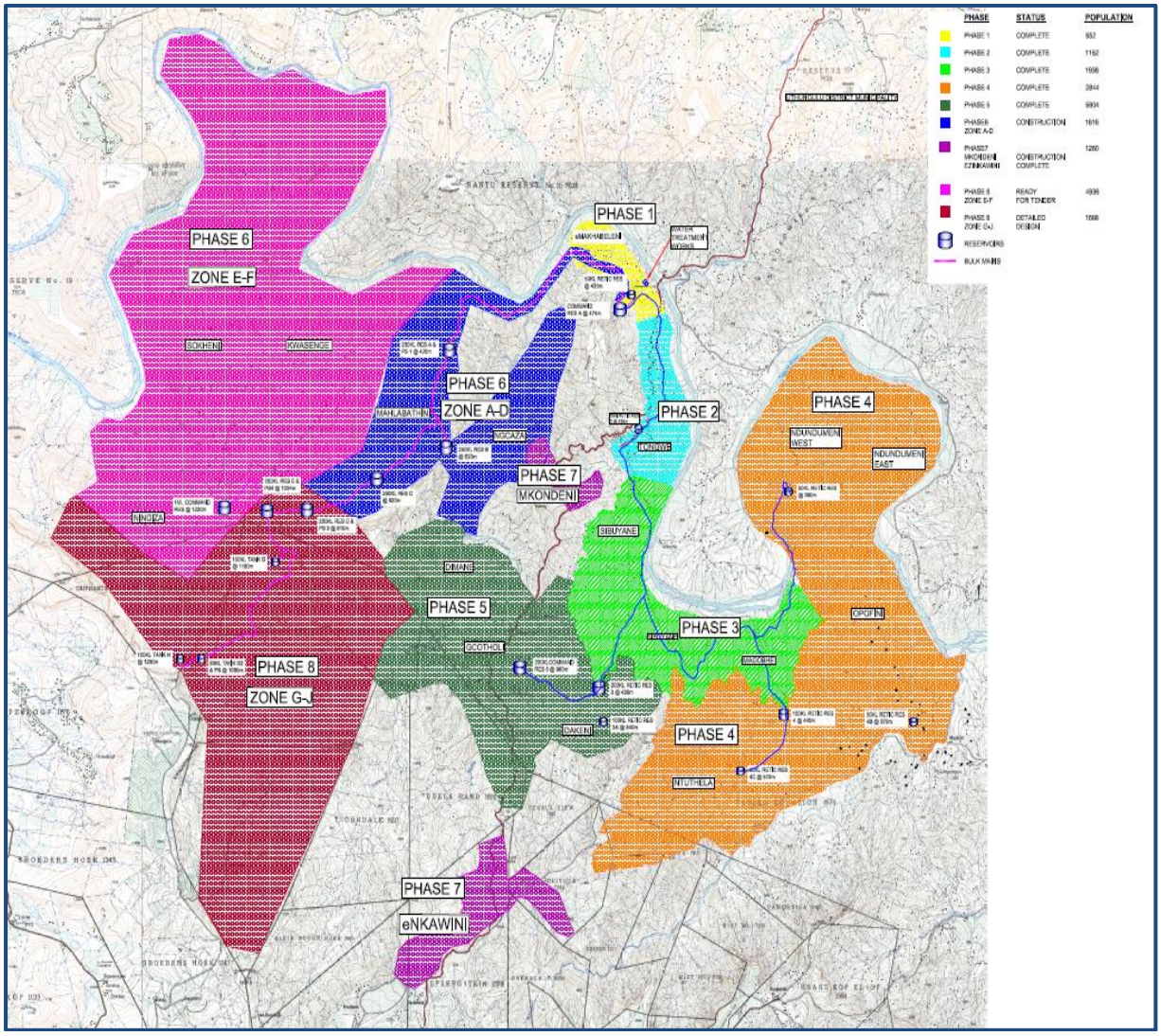


**Figure 15.5 Spatial layout of the Makhabeleni Supply System.**

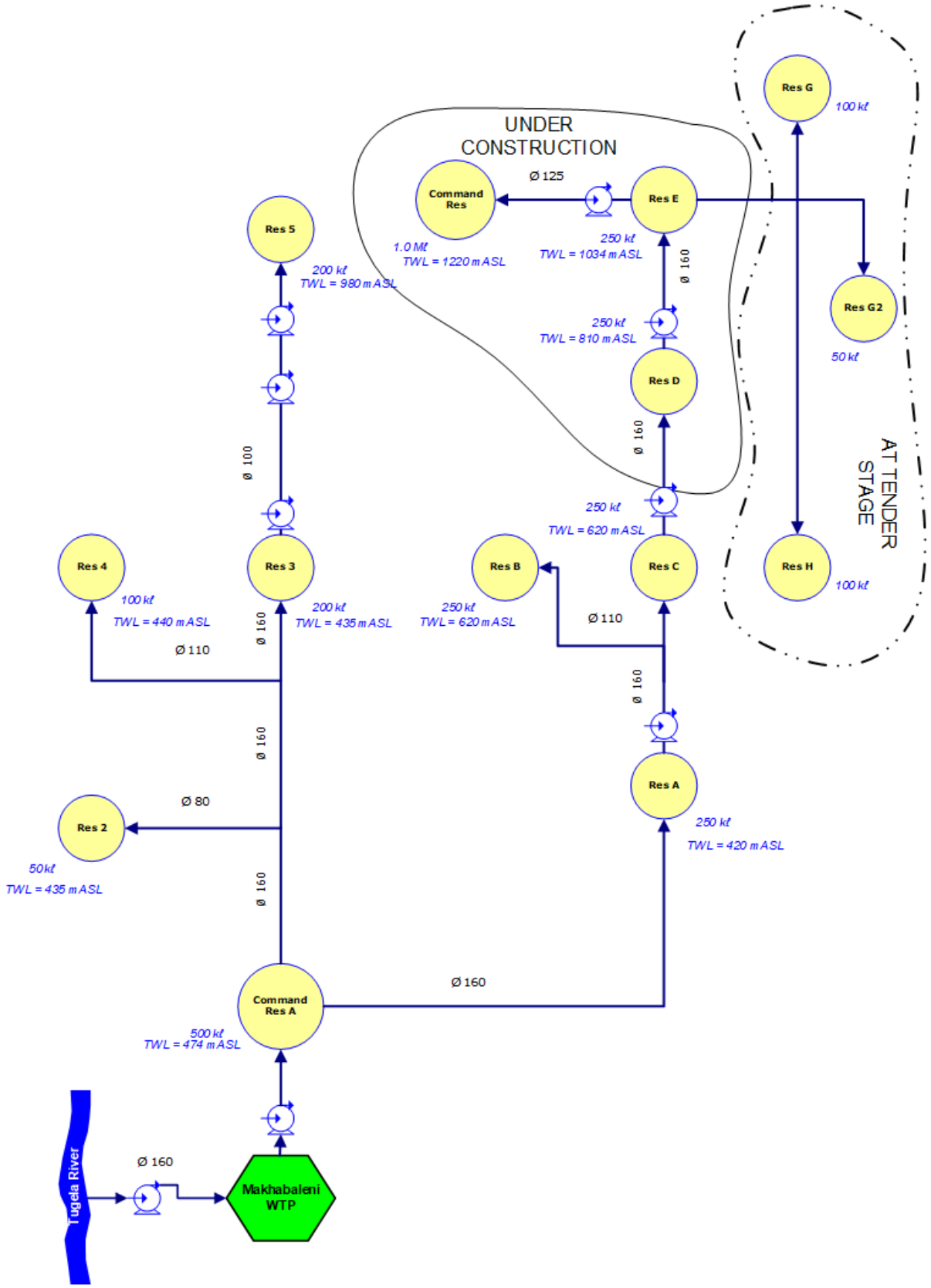


**Figure 15.6 Schematic of the Makhabeleni Supply System.**

## Table 15.5 Characteristics of the Makhabeleni WTP.

| | |
|---|---|
| **WTP Name:** | Makhabeleni WTP |
| **System:** | Tugela Supply System |
| **Maximum Design Capacity:** | 4 Mℓ/day |
| **Current Utilisation:** | 2.0 Mℓ/day |
| **Raw Water Storage Capacity:** | 0 Mℓ |
| **Raw Water Supply Capacity:** | 2.0 Mℓ/day due to constraint of abstraction works |
| **Pre-Oxidation Type:** | None |
| **Primary Water Pre-Treatment Chemical:** | Polymeric Coagulant |
| **Total Coagulant Dosing Capacity:** | 13 ℓ/hour (running at 50%) |
| **Rapid Mixing Method:** | Conventional Paddle Flash Mixer |
| **Clarifier Type:** | Dortmund manual clarifiers |
| **Number of Clarifiers:** | 6 (2 old and 4 new) |
| **Total Area of all Clarifiers:** | 140.4 $m^2$ (28.08 $m^2$ old and 112.32 $m^2$ New) |
| **Total Capacity of Clarifiers:** | 4.5 Mℓ/day |
| **Filter Type:** | Constant Rate Rapid Gravity Filters |
| **Number of Filters:** | 8 (2 Old and 6 New) |
| **Filter Floor Type** | Laterals with Nozzles |
| **Total Filtration Area of all Filters** | 83.64 $m^2$ |
| **Total Filtration Design Capacity of all Filters:** | 4 Mℓ/day |
| **Total Capacity of Backwash Water Tanks:** | 0$m^3$ |
| **Total Capacity of Sludge Treatment Plant:** | None |
| **Capacity of Used Washwater System:** | 0 Mℓ/day |
| **Primary Post Disinfection Type:** | Sodium Hypocloride |
| **Disinfection Dosing Capacity:** | 13 ℓ NaOCl/hr |
| **Disinfectant Storage Capacity:** | |
| **Total Treated Water Storage Capacity:** | 0.5 Mℓ |

## Table 15.6 Pump details: Makhabeleni Supply System.

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| Makhabeleni | Raw Water (WTP) | 1 | 1 | (Was KSB ELK 40) Ops replaced with Gorman Rupp? | Tugela Abstraction | Makhabeleni WTP Pre-settlement Tank | 32.8m | 35.23m | 4.24 |
| Makhabeleni | Potable Water High Lift (WTP) (Umzinyathi) | 2 | 1 | KSB WKLn 65/6 | WTP | Command Reservoir | 166.1m | 194m | 2.0 |
| Makhabeleni | Potable Water High Lift (WTP) B (Uthungulu) | 2 | 1 | KSB WKLn 65/6 | WTP | Uthungulu Reservoir | 192.8m | 217m | 2.0 |
| Makhabeleni | Phase 4 | 1 | 1 | Grundfos CR 3-31 | Ph4 Res 4 Bulk | Res 4 C | 135m | 160m | 0.125 |
| Makhabeleni | Phase 5 (Lift 1A) | 1 | 1 | TBC | Ph3 Reservoir | Tank 2 | 201m | 222m | 0.48 |
| Makhabeleni | Phase 5 (Lift 1B) | 1 | 1 | TBC | Ph3 Reservoir | Dakeni Res 3b | 122m | 137m | 0.107 |
| Makhabeleni | Phase 5 (Lift 2) | 1 | 1 | TBC | Tank 2 | Tank 3 | 169m | 189m | 0.48 |
| Makhabeleni | Phase 5 (Lift 3) | 1 | 1 | TBC | Tank 3 | Ph 5 Command Res | 190m | 210m | 0.48 |
| Makhabeleni | Phase 6 (Lift 1A) | 1 | 1 | Grundfos CR 5-36 | Res 6A | Res 6B | 190.4 | 234 | 0.099 |
| Makhabeleni | Phase 6 (Lift 1B) | 1 | 1 | Grundfos CR 45-10 | Res 6A | Res 6C | 188.7 | 255.5 | 0.828 |
| Makhabeleni | Phase 6 (Lift 2) | 1 | 1 | Grundfos CR 45-10 | Res 6C | Res 6D | 207.1 | 232.8 | 0.810 |
| Makhabeleni | Phase 6 (Lift 3) | 1 | 1 | Grundfos CR45-11 | Res 6D | Res 6E | 226.4 | 247.7 | 0.764 |
| Makhabeleni | Phase 6 (Lift 4A) | 1 | 1 | Grundfos CR32-14 | Res 6E | Res6F (Command) | 206.1 | 221.8 | 0.642 |
| Makhabeleni | Phase 6 (Lift 4B) | 1 | 1 | TBC | Res 6E | Res G1 (future) | 132.8 | 154.5 | 0.316 |
| Makhabeleni | Phase 6 (Lift 5) | 1 | 1 | Grundfos CRE1-27 | Tank F1 | Tank F2 (under construct) | 100m | 106m | 0.023 |
| Makhabeleni | Ph 7 (Ezinkawini) | 1 | 1 | Grundfos CRE 10-17 | Tank E1 | Tank E2 | 224m | 245.4m | 0.171 |
| Makhabeleni | Ph 7 (Mkondeni) | 1 | 1 | Grundfos CR 5-36 | Tank M1 | Tank M2 | 199m | 214m | 0.071 |

**Table 15.7 Reservoir details: Makhabeleni BWSS.**

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (aMSL) | FL (aMSL) |
|---|---|---|---|---|---|---|
| Makhabeleni | Makhabeleni | Command Res A | 0.500 | Distribution | 474 | 468# |
| Makhabeleni | Makhabeleni | Res 2 | 0.050 | Terminal | 435 | 429# |
| Makhabeleni | Makhabeleni | Res 3 | 0.200 | Distribution | 435 | 431# |
| Makhabeleni | Makhabeleni | Res 4 | 0.100 | Distribution | 440 | 436# |
| Makhabeleni | Makhabeleni | Res 5 | 0.200 | Terminal | 980 | 976# |
| Makhabeleni | Makhabeleni | Res A | 0.250 | Distribution | 420 | 416# |
| Makhabeleni | Makhabeleni | Res B | 0.250 | Terminal | 620 | 615# |
| Makhabeleni | Makhabeleni | Res C* | 0.250 | Distribution | 620 | 615# |
| Makhabeleni | Makhabeleni | Res D* | 0.250 | Distribution | 810 | 805# |
| Makhabeleni | Makhabeleni | Res E* | 0.250 | Distribution | 1034 | 1030# |
| Makhabeleni | Makhabeleni | Res G** | 0.100 | Terminal | 1160 | 1155# |
| Makhabeleni | Makhabeleni | Res G2** | 0.050 | Terminal | 1090 | 1085# |
| Makhabeleni | Makhabeleni | Res H** | 0.100 | Terminal | 1230 | 1225# |
| Makhabeleni | Makhabeleni | Res F** | 1.0 | Distribution | 1230 | 1225# |

*Under construction (anticipated completion is end 2020); **At tender stage; #An estimate of reservoir depth

## Table 15.8 Pipeline details: Makhabeleni BWSS.

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| Makhabeleni | Raw water pipeline | Abstraction works | Makhabeleni WTP | 0.127 | 160 | uPVC | 2.6** | 3 |
| Makhabeleni | Potable water pipeline | Makhabeleni WTP | Command Res A | 0.947 | 160 | uPVC | 2.6** | 3 |
| Makhabeleni | Potable water pipeline | Command Res A | Res 2 | 4.652 | 160 | uPVC | 2.6** | 3 |
| Makhabeleni | Potable water pipeline | Command Res A | Res 3 | 11.91 | 160 | uPVC/HDPE | 2.6** | 3 |
| Makhabeleni | Potable water pipeline | Res 3 | Res 5 | 2.916 | 100 | Klambon | 1.02** | 3 |
| Makhabeleni | Potable water pipeline | Command Res A | Res 4 | 16.617 | 160/110 | uPVC | 1.23** | 3 |
| Makhabeleni | Potable water pipeline | Command Res A | Res A | 8.556 | 160 | uPVC | 2.6** | 3 |
| Makhabeleni | Potable water pipeline | Res A | Res B | 2.983 | 110/75 | uPVC/HDPE | 0.572** | 3 |
| Makhabeleni | Potable water pipeline | Res A | Res C | 4.165 | 110 | uPVC | 1.23** | 3 |
| Makhabeleni | Potable water pipeline | Res C | Res D | 2.393 | 125 | uPVC | 1.59** | 3 |
| Makhabeleni | Potable water pipeline | Res D | Res E | 1.196 | 125 | uPVC | 1.59** | Under construction |
| Makhabeleni | Potable water pipeline | Res E | Res F | 1.730 | 125 | Steel | 1.59** | Under construction |
| Makhabeleni | Potable water pipeline | Res E | Res G | 1.162 | 110 | HDPE | 1.23** | Planned |
| Makhabeleni | Potable water pipeline | Res E | Res G2 | 5.553 | 110 | HDPE | 1.23** | Planned |
| Makhabeleni | Potable water pipeline | Res G2 | Res H | 1.080 | 110 | HDPE | 1.23** | Planned |

* Based on a velocity of 2 m/s ** Based on a velocity of 1.5 m/s # Age need to be verified

### 15.3.2 Status Quo and Limitations of the Middle uThukela System

#### (a) Makhabeleni WTP and Supply System

The Makhabeleni BWSS has recently been upgraded and is adequate to meet current and future demand.

The only and greatest constraint is the raw water abstraction, which is limited to 2 Mℓ/day. It is proposed that a feasibility study be undertaken to investigate an upgrade of the abstraction works.

## 15.4 Water Balance/Availability

The Vutshini-Nkandla Regional Water Supply Scheme is supplied mainly from run-of-river abstraction from the Vutshini Stream and the Vove Dam (yield of 0.33 Mℓ/day), Mhlatuze River (yield of 1.34 Mℓ/day) and uThukela River (yield of 1 Mℓ/day). The source yield will be insufficient to cater for the requirements of the Vutshini-Nkandla Scheme.

A dam on the Nsuze River is recommended to supply the future demand of the Vutshini-Nkandla regional scheme, the preliminary hydrological investigations indicate that a dam impounding 31 Million $m^3$ will have a sufficient yield of 19 Mℓ/day for the scheme (UAP Phase 3, 2019).

## 15.5 Recommendations for the Middle uThukela System

### 15.5.1 System Components

#### (a) Makhabeleni WTP and Supply System

The Makhabeleni BWSS has recently been upgraded and is adequate to meet current and future demand in the Umzinyathi portion of the Middle uThukela System.

The only and greatest constraint is the raw water abstraction, which is limited to 2 Mℓ/day. It is recommended that a feasibility study be undertaken to investigate the upgrade of the abstraction works.

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# 16. UMHLATHUZE SYSTEM

## 16.1 Synopsis of the uMhlathuze System

With a total catchment area of approximately 5 652.5 km$^2$ (WR2012 Secondary Catchments GIS Dataset), the uMhlathuze Water Resource Region (W1 secondary catchment) is composed of the uMhlathuze River (W12 tertiary catchment), Mlalazi River (W13 tertiary catchment) and Matigulu River (W11 tertiary catchment) catchments (**Figure 16.1**). Four Water Service Authorities (WSA) are located in the uMhlathuze Water Resource Region (**Figure 16.1**):

i) A small portion of the Zululand WSA is located in the north-west of the uMhlathuze Region.
ii) The King Cetshwayo WSA.
iii) The City of uMhlathuze WSA.
iv) The northern portion of the iLembe WSA is located in the Matigulu portion of the uMhlathuze Region.

The headwaters of the uMhlathuze River is located approximately 0.42 km from the Zululand-King Cetshwayo District Municipal boundary[1] (2830BD 1 : 50 000 Topographic Map 2013), approximately 1.8 km south-west of the Babanango Hill (Trig Beacon 308 at an elevation of 1598.1 mASL) and approximately 10.87 km south-west of the settlement of Babanango (Ulundi Local Municipality) as the crow flies. Babanango is located on the uMhlathuze-Mfolozi watershed. From the uMhlathuze headwaters, the river meanders in a south-easterly direction, passing the town of Nkandla (Nkandla Local Municipality) in the west and the town of Melmoth (Mthonjaneni Local Municipality) in the east. At the Nkandla-Mthonjaneni-uMlalazi local municipal boundary, the uMhlathuze River flows eastward, passing the town of Eshowe in the south. At the Mthonjaneni-uMlalazi-uMhlathuze local municipal boundary, the uMhlathuze River meanders in a southerly direction, passing the town of Empangeni in the east before discharging into Richards Bay (formerly called the uMhlathuze Bay/Lagoon[2]), the deepest natural harbour in Africa (Wikipedia 2020: website[3]) and the "largest port in South Africa by tonnage, handling about 89 million tonnes of cargo per year (by means of over 1800 commercial vessel calls), equating to about 40% of South Africa's total port demand" (KZN Planning Commission 2018: 118).

The integrated uMhlathuze System consists of:

- Goedertrouw Dam is the largest water resource in the system, and supplies to the Goedertrouw WTP below the dam wall. The dam also makes releases for abstraction at the Mhlathuze Weir for Irrigation, Industry and Domestic water use. At the weir, water is pumped north to Nsezi WTP, as well as south towards users around Lake Cubhu.
- The local coastal lakes include, Lake Nsezi, Lake Cubhu, Lake Mzingazi and Lake Nhlabane. These lakes are augmented by abstractions from the Mfolozi River by Richards Bay Minerals as well as the abstractions at the Mhlathuze Weir as mentioned above.
- The Middledrift Transfer Scheme was built as a drought emergency scheme in 1997. This scheme can pump around 1 m$^3$/s from the uThukela River over the divide into the

[1] 2016 municipal boundary (Municipal Demarcation Board).
[2] Jones 2014:1.
[3] https://en.wikipedia.org/wiki/Richards_Bay.

Goedertrouw Dam. A doubling of the Middledrift transfer scheme capacity from 1 to 2 $m^3/s$ has recently been commissioned.

In addition to the uMhlathuze River, water supply to the Richards Bay area is reliant on the coastal freshwater lakes of Mzingazi, Nhlabane, Nsezi, Cubhu and Mangeza and the coastal primary aquifers (Kelbe and Germishuyse 2001: 45).

Umgeni Water currently does not operate any infrastructure in the uMhlathuze System.

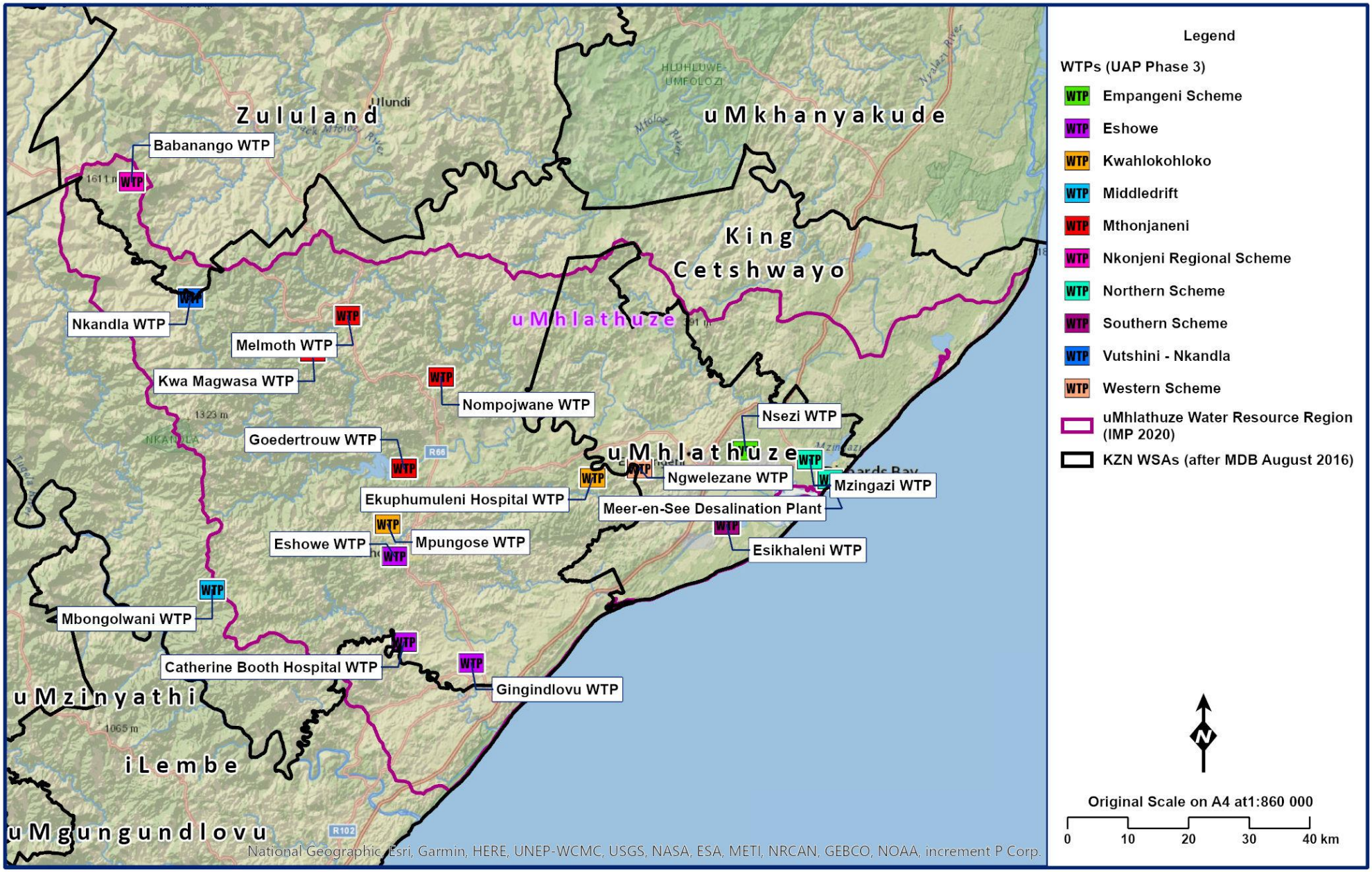



**Figure 16.1 General layout of the uMhlathuze System.**

# 16.2 Water Resources of the uMhlathuze System

## 16.2.1 Description of the uMhlathuze System Water Resource Regions

### (a) uMhlathuze Region

#### (i) Overview

From the uMhlathuze headwaters, the river meanders in a south-easterly direction for approximately 4.2 km, at which point it becomes the Zululand-King Cetshwayo District Municipal boundary[4] (2830BD 1 : 50 000 Topographic Map 2013). The uMhlathuze River continues to meander in a south-easterly direction, with the Gologodo River joining the uMhlathuze River upstream of the Riversmeer and Phambana settlements[5] (2831AC 1 : 50 000 Topographic Map 2013). An unnamed dam on the Gologodo River (approximately 2 km south-west of Babanango as the crow flies) supplies Babanango via a water treatment plant (WTP) located immediately downstream of the dam wall (**Figure 16.2**).

The uMhlathuze River continues meandering in a south-easterly direction with the Gosweni, Mbizweni, Manzimnyama and Ngwekweni Rivers flowing into the uMhlathuze River from the west across Ingoyama Trust Board (ITB) land (2831AC 1 : 50 000 Topographic Map 2013). Approximately 2 km downstream of the uMhlathuze-Ngwekweni confluence is the weir at which the abstraction point for the Nkandla WTP (located approximately 150 m north-east of the P226 bridge over the uMhlathuze River) is located (2831AC 1 : 50 000 Topographic Map 2013). At the P226 bridge, the Zululand-King Cetshwayo District Municipal boundary stops following the uMhlathuze River, with the river flowing in a southerly direction and the Xhaphozini and Nomasila Rivers joining the uMhlathuze River from the east.

The Ntumbeni River, located south of the Nkandla cemetery and wastewater works (WWW), flows east across ITB land, joining the Madiyana River (also on ITB land), located east of Nkandla, which discharges into the uMhlathuze River (2831AC 1 : 50 000 Topographic Map 2013). The uMhlathuze River meanders in a south-easterly direction with the Nyawashune River joining it from the west from the Middle uThukela-uMhlathuze watershed (2831CB 1 : 50 000 Topographic Map 2013). The uMvuzane River meanders from the west, passing the KwaNtoza Hill (Trig Beacon 256 at an elevation of 843.8 mASL), with the Bomvana River joining it from the south, downstream of the KwaNtoza Hill before it flows into the uMhlathuze River (2831CD 1 : 50 000 Topographic Map 2013). The Nhlisa River flows from the south into the uMhlathuze River downstream of the Bomvana-uMhlathuze confluence (2831CD 1 : 50 000 Topographic Map 2013). Thereafter the uMhlathuze River flows into Goedertrouw Dam (in the Nkwaleni Valley (2831CD 1 : 50 000 Topographic Map 2013).

Tributaries flowing into Goedertrouw Dam from the south include Vuma, Ndlovane and Ncemaneni (2831CD 1 : 50 000 Topographic Map 2013)). The Manzini River, whose headwaters are near the St. Mary's Hospital in the KwaMagwaza settlement (2831CB 1 : 50 000 Topographic Map 2013), meanders from the north into the KwaMazula River which flows into Goedertrouw Dam (2831CB 1 : 50 000 Topographic Map 2013).

[4] 2016 municipal boundary (Municipal Demarcation Board).

[5] Approximately 1.7 km south-east of Owen's Cutting (2831AC 1 : 50 000 Topographic Map 2013).

The uMhlathuze meanders eastward from the Goedertrouw Dam Wall, with tributaries including the Mfule flowing into it from the north-west. Tributaries of the Mfule include the Mfulazane on which the Melmoth Off-Channel Storage Dam (2831CB 1 : 50 000 Topographic Map 2013) is located. At the Majaji-uMhlathuze confluence (the Ntambanana River whose headwaters are located south the of the Ntambanana settlement is a tributary of the Majaji River) the uMhlathuze River flows in a south-easterly direction, passing the town of Empangeni on the east. The uMhlathuzana River discharges into the uMhlatuze River from the west and the Mpangeni River flowing on the outskirts of Empangeni via the Mpangeni Lake into the uMhlathuze River from north (2831DD 1 : 50 000 Topographic Map 2013). The uMhlathuze River then flows eastwards, passing the Sigwenyane and Niwe Lakes to the east and the Mangeza Lake, adjacent to the University of Zululand to the west. It continues to meander eastward with the Nseleni River flowing into it from the north, passing the weir from which water is abstracted for Empangeni before it discharges into the uMhlathuze Estuary.

The Richards Bay harbour was developed in the 1970s with the construction of a 4 km berm which divided the uMhlathuze estuary into two compartments. The northern part of the estuary was developed as a deep water harbour while the southern part was retained as a natural estuary, commonly referred to as "the sanctuary" (Kelbe and Germishuyse 2001: 47; DWS 2015: 16). The uMhlathuze River was canalised and the natural flow of the river diverted into "the sanctuary" and "in 1975, a new mouth was dredged through the sandbar approximately 5 km to the south of the original mouth" (DWS 2015: 16).

Lake Mpangeni, Lake Sigwenyane, Lake Niwe and Lake Mangeza are identified as "off-channel lakes". Kelbe and Germishuyse explain that:

> "Several small catchment rivers flowing into the uMhlathuze River just upstream of the old N2 road bridge, do not have sufficient flow to maintain an open channel connection. The lower reaches of these rivers in the uMhlathuze flood plain have been blocked by sand bars and have formed small lakes. These lakes have formed in the incised valleys with shallow soils overlying granitic formations. Consequently, these off channel lakes function in a different manner to the coastal lakes situated in a highly permeably sedimentary aquifer.
>
> These off-channel lakes along the uMhlatuze River are considered to be dominated by both surface runoff characteristics and groundwater seepage through the lake. The discharge is generally through groundwater into the uMhlathuze River."
>
> (Kelbe and Germishuyse 2001: 49)

The headwaters of the Nseleni River are located to the north, approximately 3 km from the uMhlathuze-Mfolozi watershed and approximately 1 km from the Ndondondwana settlement as the crow flies (2831DA 1 : 50 000 Topographic Map 2013). The Nseleni River meanders eastward and at the confluence with the Mvuzane River (2831DB 1 : 50 000 Topographic Map 2013), it flows southward with the Okula River joining it from the west. The Nseleni-Okula confluence is located approximately 7 km west of the Nseleni settlement as the crow flies and approximately 320 m east of the Reding Dam Wall (2831DB 1 : 50 000 Topographic Map 2013). The Okula River is located to the north of Empangeni. The Nseleni River meanders to the south of the Ntseleni settlement, forming the eastern boundary of the Enseleni Nature Reserve before flowing into the Nsezi Lake (2831DB 1 : 50 000 Topographic Map 2013).

Lake Nsezi is "located on the western edge of the coastal plain" (Kelbe and Germishuyse 2001: 50). This coastal plain is:

> "… the largest primary aquifer in southern Africa, extending from Mtunzini on the Zululand coast up through Maputaland for the full length of the Mozambique coastal zone. This region is very flat with highly permeable soils that promotes a rapid recharge to the aquifer. The uppermost formation on this coastal plan is an uncontrolled aquifer which has as its upper boundary a "water table" that is the top of the saturated zone."
>
> (Kelbe and Germishuyse 2001: 17)

Lake Nsezi is therefore considered to have a significant groundwater component (**Section 16.2.1 (a)(iii)**) but is controlled to a large extent by the Nseleni River that is situated in a very different geological region" (Kelbe and Germishuyse 2001: 50). Lake Nsezi is therefore called a "combination lake" (Kelbe and Germishuyse 2001: 50). Lake Nsezi further obtains water via a weir on the uMhlathuze River to "supplement water that is abstracted from the lake for industrial and domestic use" (Jones 2014: 31).

Rivers flowing into Lake Mzingazi, a coastal lake (Kelbe and Germishuyse 2001: 49), include Nundwane from the north and Mpisini and Bhodlisa from the north-east (2832CA 1 : 50 000 Topographic Map 2013). Kelber and Germishuyse explain coastal lakes as follows:

> "… coastal lakes have significant flow-through characteristics where there is generally continuous and simultaneous recharge and discharge through various parts of the lake bed to the aquifer. Generally, this seepage rate is greatest at the surface shoreline and decreases exponentially with distance underneath the lake. It has been assumed that the Zululand coastal lakes also have direct interaction with the aquifer and that they have similar seepage characteristics. Consequently, these lakes are assumed to be supplied through direct rainfall interception, surface runoff from riparian zones, streamflow and groundwater recharge. The lakes in the Richards Bay area which are controlled by subsurface conditions include Lake Nhlabane, Lake Mzingazi and Lake Qhubu."
>
> (Kelber and Germishuyse 2001: 49)

Lake Mzingazi has two main compartments with the "southern part of the lake separated from the northern part by a very shallow and narrow section that is exposed during extremely dry conditions" (Kelbe and Germishuyse 2001: 51). Kelbe and Germishuyse identified that the "southern compartment is approximately 14 m below mean sea level at its deepest point and is therefore susceptible to saline intrusion under adverse conditions" (2001: 51).

Rivers flowing into Qhubu Lake, a coastal lake, include Mzingwenya and Mpembeni (2831DD 1 : 50 000 Topographic Map 2013). Kelber and Germishuyse elaborate as follows:

> "Lake Qhubu is situated to the south of the Richards Bay Harbour and is assumed to have originally been part of the uMhlathuze Estuary but has become isolated by deposition processes on the northern sections of the lake. During flood events, the overflow from the lake is believed to flow through this section directly into the uMhlathuze estuary via a small channel linked to a series of canals on the uMhlathuze floodplain."
>
> (Kelber and Germishuyse 2001: 64)

The headwaters of the Mlalazi River is located approximately 3 km north-east of the Entumeni Nature Reserve as the crow flies. It flows approximately 3.5 km in a south-easterly direction into the Ihlazi Dam and then into the Rutledge Park Dam with the D313 road separating the two dams (2831CD 1 : 50 000 Topographic Map 2013). The Ihlazi Dam and the Rutledge Park Dam are located north of the Dlinza Nature Reserve and Eshowe. The Mlalazi River meanders north of Eshowe and then eastward with tributaries including the Mtilombo, Ndlovini and Tondo flowing in from the north and the Mkukuze and Bhadi flowing in from the west (2831DC 1 : 50 000 Topographic Map

2013), before it flows east around Mtunzini and north of the Umlalazi Nature Reserve, into the Indian Ocean (2831DD 1 : 50 000 Topographic Map 2013).

The headwaters of the Matigulu River is located approximately 440 m west of the Osulgulweni settlement and approximately 850 m south-east of Trig Beacon 79 at an elevation 856.5 mASL on the uMhlathuze-Lower uThukela watershed. It meanders in a southerly direction, flowing through wetlands at Mpongolwane (2831CC 1 : 50 000 Topographic Map 2013) and then heads eastward with the Matimefu River joining it from the north (2831CD 1 : 50 000 Topographic Map 2013). As the Matigulu River continues meandering eastward, the uMngwenya joins it from the west and the Mkono, Nwaku and Mpushini (with its headwaters located south of the Dlinza Nature Reserve) joining it from the north (2831CD 1 : 50 000 Topographic Map 2013). At the Mpushini-Matigulu confluence, the Matigulu turns southward, with Honothi and the Mombeni flowing into it from the west and the Bumba River from the north (2831CD 1 : 50 000 Topographic Map 2013). The Matigulu River continues meandering southward, passing the Catherine Booth Hospital on the east (2831CD 1 : 50 000 Topographic Map 2013), the Msunduze River discharging into it from the west (2931AB 1 : 50 000 Topographic Map 2013) and the Nyezane River flowing into it from the north (2931BA 1 : 50 000 Topographic Map 2013). The settlement of Gingindlovu is located approximately 5.6 km north of the Nyezane-Matigulu confluence (2931CD 1 : 50 000 Topographic Map 2013). The Matigulu River flows in a south-easterly direction and at the confluence with the iNoyoni River, which flows parallel to the coast, turns eastward into the Matigulu Lagoon (2931BA 1 : 50 000 Topographic Map 2013).

### (ii) Surface Water

It is shown in that the predominant land cover categories in the uMhlathuze Water Resource Region are forested land; cultivated and built-up. The hydrological characteristics for this region are summarised in **Table 16.1.**

**Table 16.1 Hydrological Characteristics of Mhlathuze Region (WR2012: Usutu-Mhlathuze Quat Info WMA 6 July2015).**

| Region | River (Catchment) | Area ($km^2$) | Annual Average | | | |
|---|---|---|---|---|---|---|
| | | | Evaporation (mm) | Rainfall (mm) | Natural Runoff (million $m^3$/annum) | Natural Runoff (mm) |
| uMhlathuze | Matigula River (W11) | 954 | 1300 | 1077 | 198.21 | 207.8 |
| | uMhlathuze River (W12) | 4209 | 1375 | 973 | 628.64 | 149.4 |
| | Mlalazi River (W13) | 498 | 1300 | 1205 | 131.84 | 264.7 |

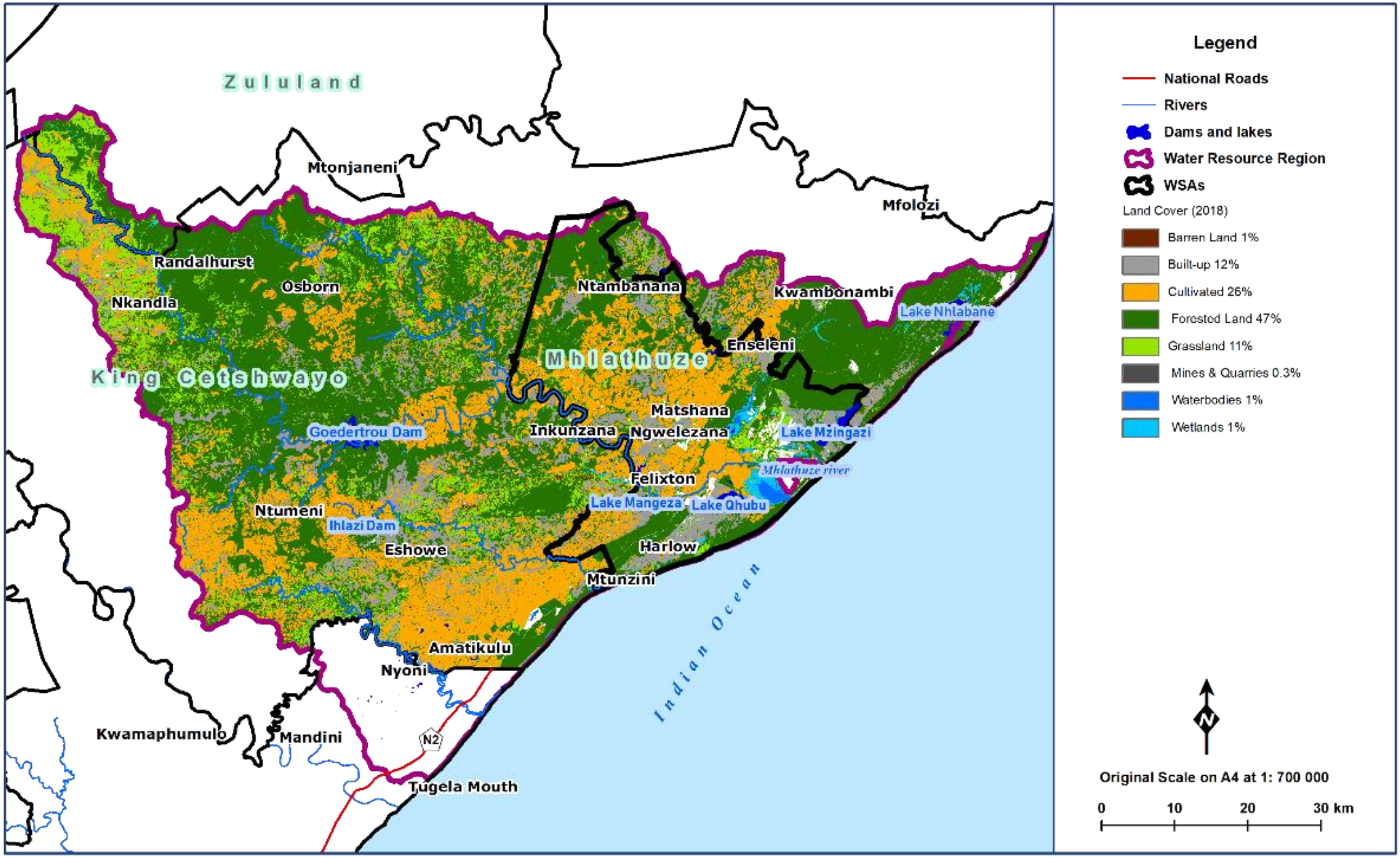



**Figure 16.2 General layout of the Mhlathuze Region (DEA and GTI 2015, KZN DoT 2017, MDB 2016, Umgeni Water 2019)**

## (iii) Groundwater

The uMhlathuze Region is located in three hydrogeological regions; the Northern Eastern Middleveld, KwaZulu-Natal Coastal Foreland and Southern Lebombo (DWAF 2008) (**Figure 16.3**).

- **Hydrogeological Units**

The oldest rocks in KwaZulu-Natal, forming part of the Kaapvaal craton, are of Swazian age and are represented, by the Nondweni Group and Empangeni Metamorphic Suite of the Barberton Sequence and its intrusive granites. These rocks are overlain by the rocks of the Pongola Supergroup. These metamorphosed sedimentary and volcanic rocks rest unconformably upon the granites.

The Natal Group outcrops in the Eshowe and Hlabisa areas, where it rests unconformably on the basement granites in parts. The Dwyka Formation rests unconformable on the Natal Group. Pietermaritzburg shale and the Vryheid Formation are the other significant sedimentary rocks in the area.

Outcrops of Karoo dolerite occur throughout the area and form massive sills that have intruded the Karoo Formation.

- **Geohydrology**

The Vryheid Formation has a very similar yield distribution to the Pietermaritzburg Shale contradicting the belief that porosity plays a role in groundwater occurrence and yield in these rocks. Dykes and sills are as important for the occurrence of groundwater in these sandstones as for that in the Pietermaritzburg Shales.

The Karoo dolerite sills can form extensive weathered and fractured aquifers with, on average, moderate borehole yields.

- **Groundwater Potential**

The groundwater resources are suitable for the development of primary rural water supply boreholes. The main constraints to exploitation are the low permeability's of the aquifers and the areally limited nature of the weathered and fractured zones of the various rocks within the area. This results in relatively low to average sustainable borehole yields.

Eighty percent of the reported borehole yields fall into the poor to moderate category (< 3 ℓ/s). Poor yields are typically found in areas of severe topography in all lithologies, but particularly where unweathered dolerite capping occur.

## (iv) Water Quality

- **Surface Water**

There is no surface water quality information available for this region at this time.

- **Groundwater**

Groundwater quality is generally good with electrical conductivity (EC) <70 mS/m. Groundwater of unacceptable quality due to excessive EC is found in areas in the Dwyka Tillite and Pietermaritzburg Formation Shales. Groundwater of acceptable quality occurs in the basement granites and Natal Group Sandstones (**Figure 16.3** ).

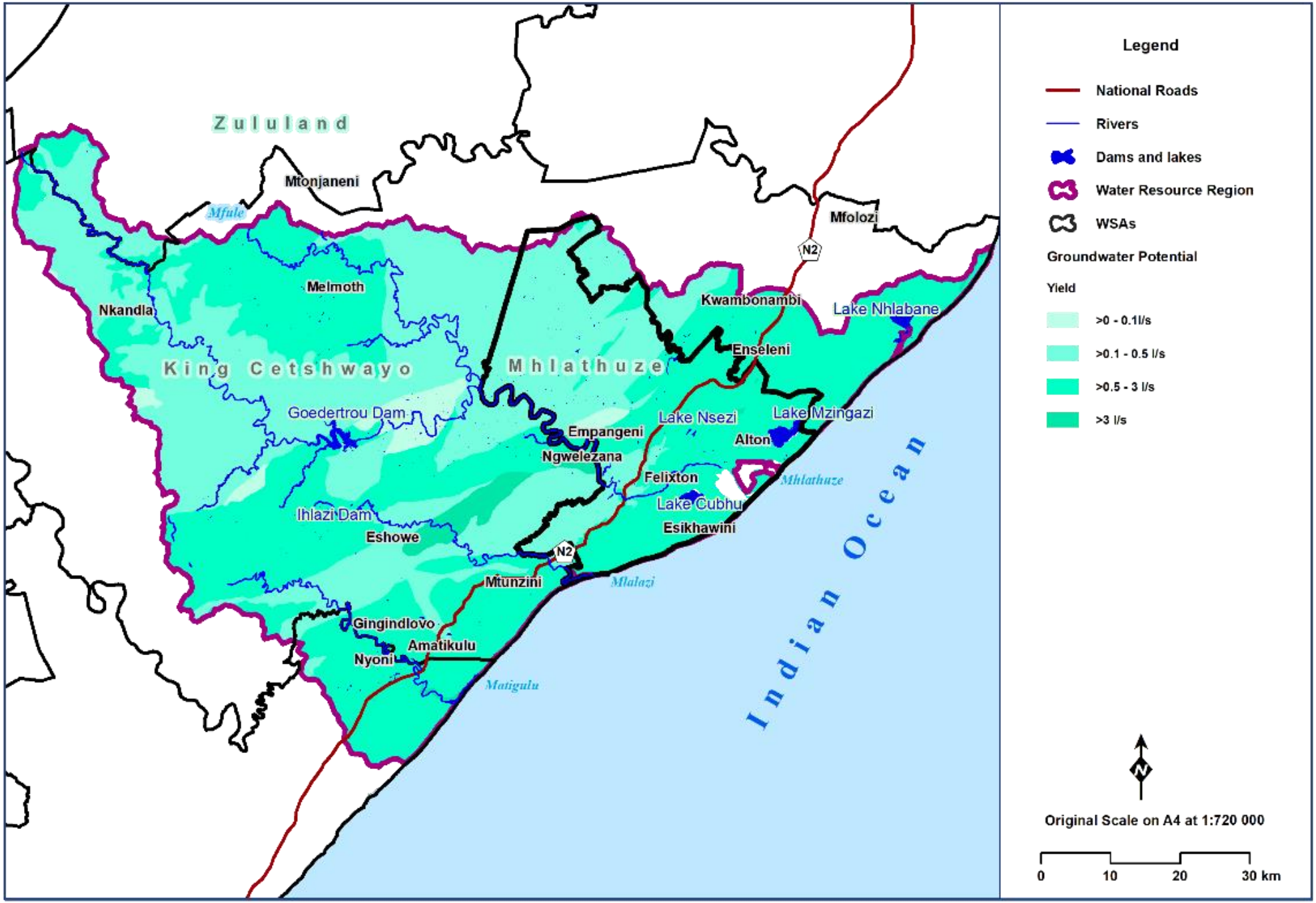



**Figure 16.3 Groundwater potential in the Mhlathuze Region (KZN DoT 2017, MDB 2016, Umgeni Water 2019, WR2012).**

## 16.2.2 Reserve

## (a) Mhlathuze Region

### (i) Nhlabane Estuary

The EWR set for the estuary was based on the assumption that water required to make the fishway operational, would be available. Establishing a partial link between the lake and estuary would result in an improvement of the functioning of the system and would be sufficient to raise the estuary to an Ecological Category C. Raising the Ecological Category to B would require continuous operation of the fish way, lowering of the barrage and rehabilitation of the riparian areas. Improvement to an ecological category A would require complete removal of all barriers and rehabilitation of the catchment (DWS 2015).

### (ii) Nhlabane Lake

A number of mining associated activities have had negative impacts on the system. These were related to the construction of a barrier between the estuary and the lake (the barrage), continued abstraction of water by Richards Bay Minerals (RBM) from the estuary itself and the effects of the RBM dredger and plant machinery crossing the estuary. The present and recommended ecological status for the lake is class C, with a high ecological importance (DWS 2015).

### (iii) Mhlatuze Estuary

The current health category of the Mhlathuze estuary is a C. The Recommended Ecological Category proposed by previous studies was a C/D according to the report by DWS (DWS 2015). It suggests there may be merit in re-assessing the Recommended Ecological Category of the Mhlathuze estuary in future.

### (iv) Mhlatuze River

The construction of Goedertrouw Dam together with extensive land use impacts on the catchment have resulted in changes in the habitat integrity, ecological status and hydrology of the river. While the river has low to moderate social importance, it has moderate to very high ecological importance, which justifies the need for the application of an Ecological Reserve. The status of the river ecology is covered in **Table 16.2**.

**Table 16.2 Mhlatuze River Ecological Status (DWS, 2009).**

| River Reach | PES | | Importance | | AEMC | |
|---|---|---|---|---|---|---|
| | Instream | Riparian | Ecological | Social | Instream | Riparian |
| Goedertrouw Dam to Mfule Confluence | C/D | E | Moderate | Moderate | C/D | D |
| Mfule Confluence to Mhlathuze Weir | C/B | D | High | Moderate | B | C/D |
| Mhlathuze Weir to Estuary | E | E | Very High | Low | N/A | |

*PES ~ Present Ecological Status*

*AEMC ~ Attainable Ecological Management Class*

## 16.2.3 Existing Water Resource Infrastructure and Yields

### (a) Mhlathuze Region

Key water resource infrastructure includes:

- Abstraction from the uMhlathuze River for the Nkandla WTP.
- Goedertrouw Dam (**Figure 16.4** and **Table 16.3**) on the uMhlathuze River as the largest water resource feeding water to the Goedertrouw WTP below the dam wall. It also releases water for irrigation and for abstraction at the uMhlathuze Weir from which industry and domestic water use is supplied.
- Middledrift Transfer Scheme which was built as a drought emergency scheme in 1997. This scheme can pump approximately $1m^3/s$ from the uThukela River over the divide into the river above Goedertrouw Dam.
- Abstraction from the Mhlathuze River upstream of the Mhlathuze Weir on the border with uMlalazi LM for the Ngwelezane WTP.
- Lake Nsezi, a "combination lake" (**Section 16.2.1 a)(i)**) and Lake Nhlabane, Lake Mzingazi and Lake Qhubu, "coastal lakes" (**Section 16.2.1 a)(i)**). These lakes are augmented by abstractions from the Mfolozi River.
- Ihlazi Dam (**Figure 16.5** and **Table 16.4**) and Rutledge Park Dam (**Figure 16.6** and **Table 16.5**) on the Mlalazi River which supply Eshowe.

**Figure 16.4 Goedertrouw Dam (Aerial photograph taken by Helene Smith shows the extent of the drop in water levels).**

**Table 16.3 Goedertrouw Dam (DWS 2018: Hydrographic Surveys Dams Database, DWS 2019: List of Registered Dams Database, WR2012).**

| | |
|---|---|
| **Catchment Details** | |
| **Incremental Catchment Area:** | 1280 $km^2$ [a] |
| **Total Catchment Area:** | 1280 $km^2$ [a] |
| **Mean Annual Precipitation:** | 876 mm [b] |
| **Mean Annual Runoff:** | 336.38 million $m^3$ [b] |
| **Annual Evaporation:** | 1450 mm [b] |
| **Dam Characteristics** | |
| **Gauge Plate Zero:** | 126 mASL [d] |
| **Full Supply Level:** | 214 mASL [d] |
| **Spillway Height:** | 88 m [c] |
| **Net Full Supply Capacity:** | 301.27 million $m^3$ [d] |
| **Dead Storage:** | 14.146 million $m^3$ [d] |
| **Total Capacity:** | 301.27 million $m^3$ [d] |
| **Surface Area of Dam at Full Supply Level:** | 12 $km^2$ [c] |
| **Original Measured Dam Capacity** | 315.42 million $m^3$ (1984) [d] |
| **Second Measured Dam Capacity** | 304.1 million $m^3$ (1987) [d] |
| **Third Measured Dam Capacity** | 301.27 million $m^3$ (2000) [d] |
| **Dam Type:** | Earth-fill [c] |
| **Crest Length:** | Crest Length: 630 m [c]<br>Spillway Section: 630 m<br>Non-Spillway Section: m |
| **Type of Spillway:** | Uncontrolled Ogee [c] |
| **Capacity of Spillway:** | 7000 $m^3/s$ [e] |
| **Date of Completion:** | 1982 [c] |
| **Date of Area Capacity Survey:** | 2000 [d] |
| **Date of next Area Capacity Survey:** | 2011 [f] (Overdue) |

[a] WR2012 quaternary catchment dataset (summation of the quaternary catchment areas contributing

[b] WR2012 Database of Quaternary Catchment Information.

[c] DWS List of Registered Dams Database (April 2019).

[d] DWS Hydrographic Surveys Dams Database (2018).

[e] SANCOLD

[f] DWS Survey Return Period

**Figure 16.5 Ihlazi Dam (also known as Eshlazi Dam) on 15 March 2017 (Zululand Pix 2017: Facebook).**

**Table 16.4 Ihlazi Dam (also known as Eshlazi Dam) (DWS 2018: Hydrographic Surveys Dams Database, DWS 2019: List of Registered Dams Database, WR2012).**

| | |
|---|---|
| **Catchment Details** | |
| **Incremental Catchment Area:** | 17 $km^2$ [a] |
| **Total Catchment Area:** | 17 $km^2$ [a] |
| **Mean Annual Precipitation:** | 1135 mm [b] |
| **Mean Annual Runoff:** | 3.72 million $m^3$ [c] |
| **Annual Evaporation:** | 1400 mm [b] |
| **Raised Dam Characteristics** | |
| **Gauge Plate Zero:** | 489 mASL [f] |
| **Full Supply Level:** | 497 mASL [f] |
| **Spillway Height:** | 8 m [e] |
| **Net Full Supply Capacity:** | 0.909 million $m^3$ [e] |
| **Dead Storage:** | N/A |
| **Total Capacity:** | 0.909 million $m^3$ [e] |
| **Surface Area of Dam at Full Supply Level:** | 0.257 $km^2$ [e] |
| **Original Measured Dam Capacity** | 0.909 million $m^3$ [e] |
| **Dam Type:** | Gravity [e] |
| **Crest Length:** | Crest Length: 147 m [a]<br>Spillway Section : 7 m [d]<br>Non Spillway Section : 140 m [d] |
| **Type of Spillway:** | Ogee Spillway [e] |
| **Capacity of Spillway:** | N/A |
| **Date of Completion:** | 1978 [e] |
| **Date of Area Capacity Survey:** | 1997 |
| **Date of next Area Capacity Survey:** | Unknown |

[a] Catchment delineated using 20m DEM and Spatial Analyst.
[b] WR2012 uThukela Quaternary Info WMA 2015 spreadsheet.
[c] Used the identify tool on WR2012 dataset on ArcGIS and converted to million $m^3$.
[d] Measured on Google Earth.
[e] DWS List of Registered Dams Database (April 2019).
[f] 0.5m Contours

**Figure 16.6 Rutledge Park Dam (Zululand Observer 2016: website).**

**Table 16.5 Rutledge Park Dam (DWS 2018: Hydrographic Surveys Dams Database, DWS 2019: List of Registered Dams Database, WR2012).**

| | |
|---|---|
| **Catchment Details** | |
| **Incremental Catchment Area:** | 1.3 $km^2$ [a] |
| **Total Catchment Area:** | 18 $km^2$ [a] |
| **Mean Annual Precipitation:** | 1135 mm [b] |
| **Mean Annual Runoff:** | 0.368 million $m^3$ [b] |
| **Annual Evaporation:** | 1300 mm [b] |
| **Raised Dam Characteristics** | |
| **Gauge Plate Zero:** | 488 mASL [f] |
| **Full Supply Level:** | 495 mASL [f] |
| **Spillway Height:** | 7 m [e] |
| **Net Full Supply Capacity:** | 0.209 million $m^3$ [e] |
| **Dead Storage:** | N/A |
| **Total Capacity:** | 0.209 million $m^3$ [e] |
| **Surface Area of Dam at Full Supply Level:** | 0.1 $km^2$ [e] |
| **Original Measured Dam Capacity** | 0.209 million $m^3$ [e] |
| **Dam Type:** | Gravity [e] |
| **Crest Length:** | Crest Length: 96 m [e] |
| **Type of Spillway:** | Ogee Spillway [e] |
| **Capacity of Spillway:** | N/A |
| **Date of Completion:** | 1925 [e] |
| **Date of Area Capacity Survey:** | N/A |
| **Date of next Area Capacity Survey:** | Unknown |

[a] DWS List of Registered Dams Database (April 2019).
[b] WR2012 uThukela Quaternary Info WMA 2015 spreadsheet.
[c] Used the identify tool on WR2012 dataset on ArcGIS and converted to million $m^3$.
[d] Measured on Google Earth.
[e] DWS List of Registered Dams Database (April 2019).
[f] 0.5m Contours

**Table 16.6 Mhlathuze System yields (DWS 2015).**

| Dam/Lake | Yield (million $m^3$/annum) | Yield (Mℓ/day) |
|---|---|---|
| Goedertrouw Dam excl. uThukela Transfer | 51.5 | 141.1 |
| Goedertrouw Dam incl. uThukela Transfer | 84.5 | 231.5 |
| Lake Nsezi | 6.6 | 18.1 |
| Lake Cubhu | 0.4 | 1.1 |
| Lake Mzingazi | 10.5 | 28.8 |
| Lake Nhlabane with support from Mfolozi | 34.5 | 94.5 |
| Lake Nhlabane without support from Mfolozi | 7.9 | 21.6 |
| **Total Yield from lakes (support from Mfolozi)** | **52.0** | **142.5** |
| **Total Yield from lakes (no support from Mfolozi)** | **25.4** | **69.6** |

The Goedertrouw Regional Scheme with Goedertrouw Dam is the most viable source to supply water to Mthonjaneni, Kwahlokohloko and Eshowe. Raw water is abstracted from Goedertrouw Dam and supplied to the Kwahlokohloko WTW and can support Rutledge Dam if required. The town of Eshowe and the Eshowe Water Supply Scheme are supplied from the Eshowe WTW positioned within the town (Umgeni Water 2019: 17).

The Mlalazi River catchment is one of the sources of supply for the Eshowe Water Supply Scheme. There is very limited water use from the catchment, with commercial forestry being the largest user. The water uses in the Upper Mhlathuze River Quaternary Catchments up to the Goedertrouw Dam impact on the yield of the dam. The main source of water supply for the Eshowe Water Supply Scheme is from Goedertrouw Dam. Municipal water use is the major water use, with Mhlathuze water having registered water use of 108.1 million m3/a from the Mhlathuze River catchment downstream of Goedertrouw Dam. (DWA 2011: 14)

The Eshowe WTP is supplied with raw water from the Rutledge and Ihlazi Dams situated on the Mlalazi River, a tributary of the Mhlathuze River. The supply is also supplemented from Goedertrouw Dam on the Mhlathuze River. Two small treatment plants, namely Catherine Booth Hospital and Obanjeni WTPs, supply the surrounding communities. The Goedertrouw Dam supplies water as far downstream as Richards Bay, including the Richards Bay Industries and other surrounding areas. The Matigulu River also supplies irrigation areas within the Eshowe Water Supply Scheme area. Commercial forestry within this area does, however, have an effect on the runoff and yield that can be obtained from the Matigulu River (DWA 2011: 14 – 19).

The Kwahlokohloko Regional Water Supply Scheme Area is supplied by the Mpungose WTP which gets its raw water from Goedertrouw Dam (Umgeni Water 2019: 18). The Middledrift regional Water Supply Scheme Area is supplied with water from the uThukela Transfer Scheme Abstraction Works (Umgeni Water 2019: 18).

DWS has recently completed a study in April 2020 to review and update of the hydrology and yields of the Mhlathuze system as part of the improvement of the 2015 Reconciliation Strategy for Richards Bay and surrounding towns.

DWS, 2020 reports that:

> Detailed yield analyses have been undertaken during the Mhlathuze Water Availability Assessment Study (MWAAS) and subsequent further analyses took place during the Support of Compulsory Licensing. No further updates to the WRYM took place as part of this study as the WRPM was used for the water availability assessment. The required yield inputs to the WRPM in the form of the short-term curves had already been undertaken. This section provides a summary of the yields of the system.
>
> The water availability in the Mhlathuze system is determined as a system yield and not just the yield of the Goedertrouw Dam and relevant Lake resources added together. This is because of the large amount of tributary runoff that occurs between the Goedertrouw Dam and the point of abstractions of the various users. In order to determine the yield, the individual abstractions at their relative locations are withdrawn from the system and combined together in a single yield node. The excess yield (over and above the total use) is abstracted from the point in the system representing the Mhlathuze weir. Using this approach, the historic firm yield (HFY) determined for the Mhlathuze system in the MWAAS, including the current available transfer from the Thukela was determined to be 245 million m3/a. The long-term stochastic yields determined in this study are shown in **Table 16.7**.

**Table 16.7 Stochastic Yields of Mhlathuze System (DWS 2020).**

| Stochastic firm yield at levels of assurance in supply ($Mm^3$/annum) | | | |
|---|---|---|---|
| **1:200** | **1:100** | **1:50** | **1:20** |
| 243.3 | 251.6 | 260.0 | 273.3 |

The short-term yield curves of the Mhlathuze System were also developed; these are to be used for short-term operation of the system based on various system storage levels (**Table 16.8**).

**Table 16.8 Short-term characteristics of Mhlathuze System (DWS 2020).**

| | **Yield $Mm^3$/annum at indicated Recurrence Interval in years** | | | | | |
|---|---|---|---|---|---|---|
| **Starting storage (% of live FSC)** | **1:200** | **1:100** | **1:50** | **1:20** | **1:10** | **1:4** |
| 100% | 207.33 | 214.00 | 227.44 | 250.46 | 269.27 | 297.76 |
| 80% | 192.48 | 202.43 | 217.12 | 239.02 | 261.36 | 295.86 |
| 60% | 174.18 | 184.10 | 198.77 | 224.01 | 247.87 | 289.51 |
| 40% | 145.33 | 158.56 | 170.54 | 193.71 | 226.94 | 270.59 |
| 20% | 101.50 | 114.83 | 126.15 | 153.84 | 179.65 | 212.59 |
| 10% | 78.39 | 87.67 | 95.95 | 107.61 | 132.34 | 164.74 |

According to DWS, 2016, both Eshlazi and Rutledge dams operate as a unit and their combined firm yield is 1.29 million $m^3$ (3.53 Mℓ/d). These dams supply the Eshowe Water Supply Scheme. The long-term yields of the dams have been assessed using three different scenarios (for optimal utilisation of the resource between the two dams).

- Scenario 1 - both dams were drawn down simultaneously.
- Scenario 2 - Rutledge was emptied before Eshlazi was utilised
- Scenario 3 - the storage in both dams was split 50/50 to ensure that water was utilisation altered between Rutledge and Eshlazi.

The results of the long-term yield analyses of the system, for different assurances of supply, are provided in **Table 16.9.** Different orders in utilisation of the storage from the two dams had very little effect of safe yield of the system. This is most likely as a result of the dams being close together and there being very little incremental catchment into the lower Rutledge Dam that could be lost through spills.

**Table 16.9 Long-term yields of Eshlazi and Rutledge dams (DWS 2016).**

| | | Yield at corresponding assurance level ($Mm^3/a$) | | |
|---|---|---|---|---|
| **Scenario** | **Description** | **1:20** | **1:50** | **1:100** |
| 1 | Dual drawdown | 2.1 | 1.77 | 1.57 |
| 2 | Rutledge fully then Eshlazi | 2.1 | 1.77 | 1.58 |
| 3 | 50/50 Stepwise drawdown with Rutledge first | 2.1 | 1.77 | 1.57 |

The DWS, 2020 study also developed short-term yield curves of the combined Eshlazi and Rutledge dams supplying the town of Eshowe; these are to be used for short-term operation of the system based on combined system storage levels (**Table 16.10**).

**Table 16.10 Short-term characteristics of combined Eshlazi and Rutledge dams (DWS 2020).**

| | Yield $Mm^3$/annum at indicated Recurrence Interval in years | | | | |
|---|---|---|---|---|---|
| **Starting storage (% of live FSC)** | **1:200** | **1:100** | **1:50** | **1:20** | **1:10** |
| 100% | 1.53 | 1.66 | 1.81 | 2.08 | 2.33 |
| 80% | 1.50 | 1.60 | 1.78 | 2.02 | 2.30 |
| 60% | 1.35 | 1.48 | 1.64 | 1.87 | 2.11 |
| 40% | 1.15 | 1.25 | 1.40 | 1.50 | 1.78 |
| 5% | 0.80 | 0.84 | 0.90 | 1.10 | 1.28 |

## 16.2.4 Operating Rules

### (a) Mhlathuze Region

The Department of Water and Sanitation prepared an Annual Operating Analysis (AOA) for the Mhlathuze Water Supply System and the Goedertrouw Dam in October 2017. The purpose of AOA is to define and optimise the short-term (Annual) allocation of water by means of operating rules. The outcome of the AOA is to minimise the risk of non-supply to high priority use in the system.

The annual operating rules for the 2017/2018 operating year were as follows:

- Proposed restrictions for the 2017/2018 operating year for the Mhlathuze WSS were:
  - Industry : 10% (which is a total sector allocation of 44 million m3/a);
  - Domestic : 20% (which is a total sector of 36 million m3/a) and
  - Irrigation : 70% original allocations (which equates to 62.5% of the revised allocations and 40% of the current unrestricted requirements of 75 million m3/a as a sector)
- Pumping through the uThukela-Goedertrouw inter-basin transfer to be maintained at 1 $m^3/s$;
- Continue pumping from the uThukela River until Goedertrouw Dam is above 75%; and
- Maximise utilisation of local resources eg. Lakes, desalination plant etc.

Continued monitoring of storage levels, dams and lakes and actual water use for all sectors are required to manage the system.

(Umgeni Water 2019: 31)

#### (i) Water Supply Operating Rules

The water supply operating rule aims to utilise resources in the most cost efficient manner while maximising the yield of the system.

A DWS report (DWS 2015) provides clarity on the two local schemes:

> "*Water releases from the bigger Eshlazi Dam (also known as Ihlazi Dam) into Rutledge Dam, where it is abstracted. There are no rules for releasing water from Eshlazi Dam, the amount of water released was determined by observing dam levels, which was conducted twice.*
> *When Rutledge Dam had drown down, a decision was made to release water from Eshlazi Dam and valve would be opened to allow releases for a few days* "
>
> *"Supply to Eshowe from the WTP at the Goedertrouw Dam now augments the existing supply from the two local dams. This water is however pumped from a much lower level (WTP elevation estimated at 185m) than the water from Rutledge Dam (estimated at an elevation of 487m). As such the water from Goedertrouw Dam is likely to be more expensive than that from the two local dams. As the source of water from the local dams is insufficient to meet the full requirement, and the capacity (and availability from Goedertrouw) is also limited, both sources will always need to supply simultaneously. However, the greater volume should first be sourced from the local cheaper resources and the balance comes from Goedertrouw."*
>
> (DWS 2015:5-2)

The DWS report further indicated that the source of water from local dams is insufficient to meet the full requirements and the greater volume should be sourced from local cheaper resources with the balance being provided from Goedertrouw Dam.

(DWS 2015: 5-3)

## (ii) Drought Operating Rules

A drought-operating rule was developed to determine the allowable volume of water that should be abstracted each year from the Rutledge and Ihlazi Dam (also known as Eshlazi Dam). The Eshowe WSS was chosen as a priority system for the development of operating rules as a result of the low storage of both the Rutledge and Ihlazi Dam.

(DWS 2015:1-1)

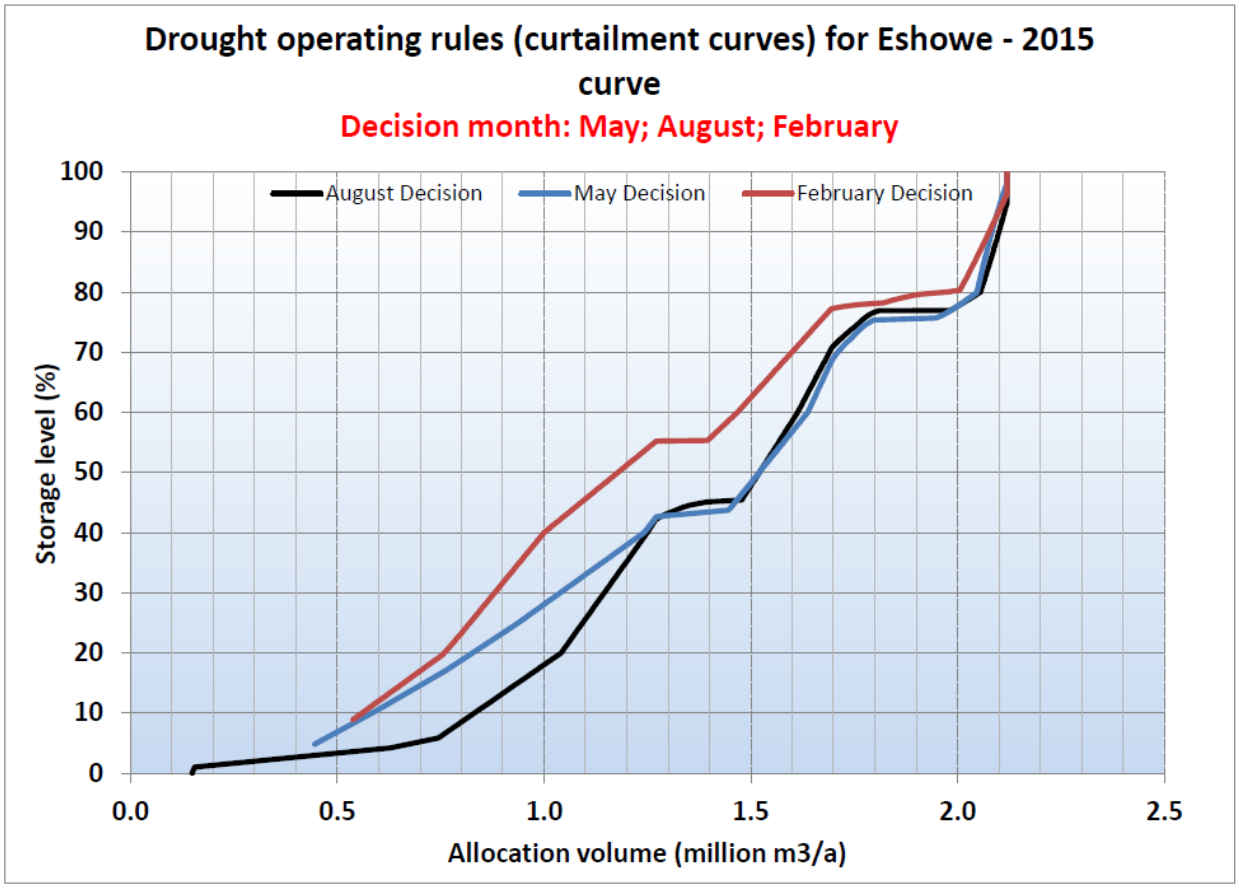
The operating rules of Eshlazi and Rutledge dam includes the following:

- If the dams were spilling then a maximum capacity of 8 Ml/d could be taken from the local resource, this being the peak capacity of the local WTW.
- Once the dam stops spilling, the abstraction should be reduced to a maximum of 5.8 Ml/d.

(DWS 2015:6-9)

The drought operating rule curtailment curves for Eshowe WSS are shown in **Figure 16.7**. The rule is based on three decision date curves (August, May and February).

**Figure 16.7 Drought Operating Rules (Curtailment curves) for Eshowe (DWS 2015:6-9)**




- The drought operating rule shows that the maximum target draft that should be allocated from the two local dams is 2.1 million $m^3$/a (5.8 Mℓ/day), when the storage volume is 100%.
- **Figure 16.7** shows that once the combined storage volumes drops below 80%, the allocation should be reduced to below 2 million m3/a (5.5 Ml/d).

- If the dam levels drop to a combined storage of approximately 50% then the recommended allocations reduce to 1.5 million $m^3/a$ (4.1 Ml/d) in winter and 1.2 million $m^3/a$ (3.3 Ml/d) in February.

The operating rules of Mhlathuze System including Goedertrouw Dam includes the following (DWS, 2020):

- Supply as much as possible of the 9 million $m^3/a$ required for smelter from Lake Nhlabane as a first resort;
- If Lake Nhlabane cannot supply the full 9 million $m^3/a$ demand, supply difference from Mhlathuze Water via Lake Nsezi;
- Supply the required 23 million $m^3/a$ for the RBM ponds from Mfolozi supply first;
- If Mfolozi supply is insufficient, then supply from Lake Nhlabane (up to a total limit of 12 million $m^3/a$ including what is supplied for the smelter); and
- Lastly, if the RBM ponds demand is still not met, then supply from Mhlathuze Water via Lake Nsezi (up to a total limit of 16 million $m^3/a$ including what is supplied for the smelter).
- The transfer from the Thukela is to take place when Goedertrouw Dam drops below 75%.

# 16.3 Supply Systems

## 16.3.1 Description of the uMhlatuze System

### (a) Overview

The uMhlathuze System is the main source of water for KCDM and the City of uMhaltuze. It supplies water to the rural settlements, urban settlements and industries in the Nkandla, Mthonjaneni, uMlalazi and uMhlatuze Local Municplity's of KCDM. uMhlatuze Local municipality is a legislated water service authority referred to as CoU. **Figure 16.8** provides an overview of the municipalities within KCDM and the relative location of CoU. It also shows the bounding District Municipalities of Zululand and Umkhanyakude to the north, Umzimyathi to the east and iLembe sharing its southern border.

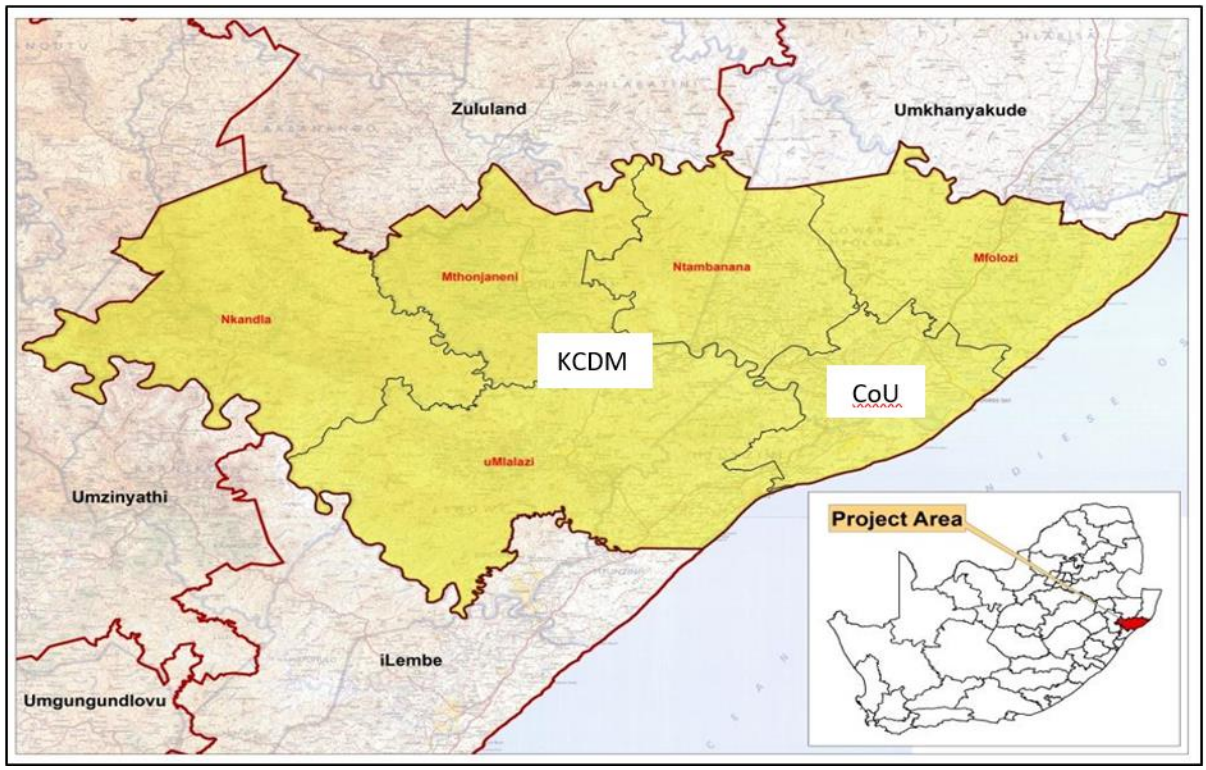



**Figure 16.8 KCDM and CoU**

The following WTP obtain its water from the uMhalthuze River. In some of these plants, the river augments supply and in the case Goedertouw WTW, supply is supplemented by an inter-basin transfer from the uThukela River. WTP's that have a treatment capacity greater than 2 Mℓ/day include the:

- Nkandla WTW;
- Middledrift WTW;
- Goedertrouw WTW;
- Eshowe WTW;
- eSikhaleni WTW;
- Nsezi WTW;
- Mzingazi WTW.

## (b) Nkandla Water Treatment Plant and Supply System

The WTP (**Figure 16.9**) abstracts water from a weir on the uMhlatuze River. The plant has a capacity of 2.5 Mℓ/day and potable water is pumped to the the Mpongose Tribal Authority and towards Nkandla Town. Associated bulk infrastructure consists of two pump stations, pumping a total head of 280 m; four bulk storage reservoirs, with a total capacity of 630 kℓ; and 67 km of bulk pipelines, ranging from 90 mm to 160 mm in diameter.

**Figure 16.9 Nkandla WTP**

The Nkandla Water Treatment Plant Supply System is shown in **Figure 16.10** and the characteristics of the plant are indicated in **Table 16.11**.

## Table 16.11 Characteristics of the Nkandla WTP

| | |
|---|---|
| **WTP Name:** | Nkandla WTP |
| **System:** | Nkandla Bulk Supply System |
| **Maximum Design Capacity:** | 3.6 Mℓ/day[1] |
| **Current Utilisation (January 2020):** | 3.6 Mℓ/day |
| **Raw Water Storage Capacity:** | 0 |
| **Raw Water Supply Capacity:** | 9 Mℓ/day |
| **Pre-Oxidation Type:** | None |
| **Primary Water Pre-Treatment Chemical:** | Floculation Channels |
| **Total Coagulant Dosing Capacity:** | Unknown |
| **Rapid Mixing Method:** | Unknown |
| **Clarifier Type:** | Sedimentation Tanks |
| **Number of Clarifiers:** | 3 |
| **Total Area of all Clarifiers:** | 4500m$^2$ |
| **Total Capacity of Clarifiers:** | Unknown |
| **Filter Type:** | Rapid Gravity |
| **Number of Filters:** | 2 |
| **Filter Floor Type** | Unknown |
| **Total Filtration Area of all Filters** | 100m$^2$ |
| **Total Filtration Design Capacity of all Filters:** | Unknown |
| **Total Capacity of Backwash Water Tanks:** | Unknown |
| **Total Capacity of Sludge Treatment Plant:** | Sludge treated at sludge lagoons |
| **Capacity of Used Washwater System:** | Unknown |
| **Primary Post Disinfection Type:** | Chlorine Contact Tanks |
| **Disinfection Dosing Capacity:** | Unknown |
| **Disinfectant Storage Capacity:** | Unknown |
| **Total Treated Water Storage Capacity:** | 500kl |

[1]DWS All Towns Study, 2011

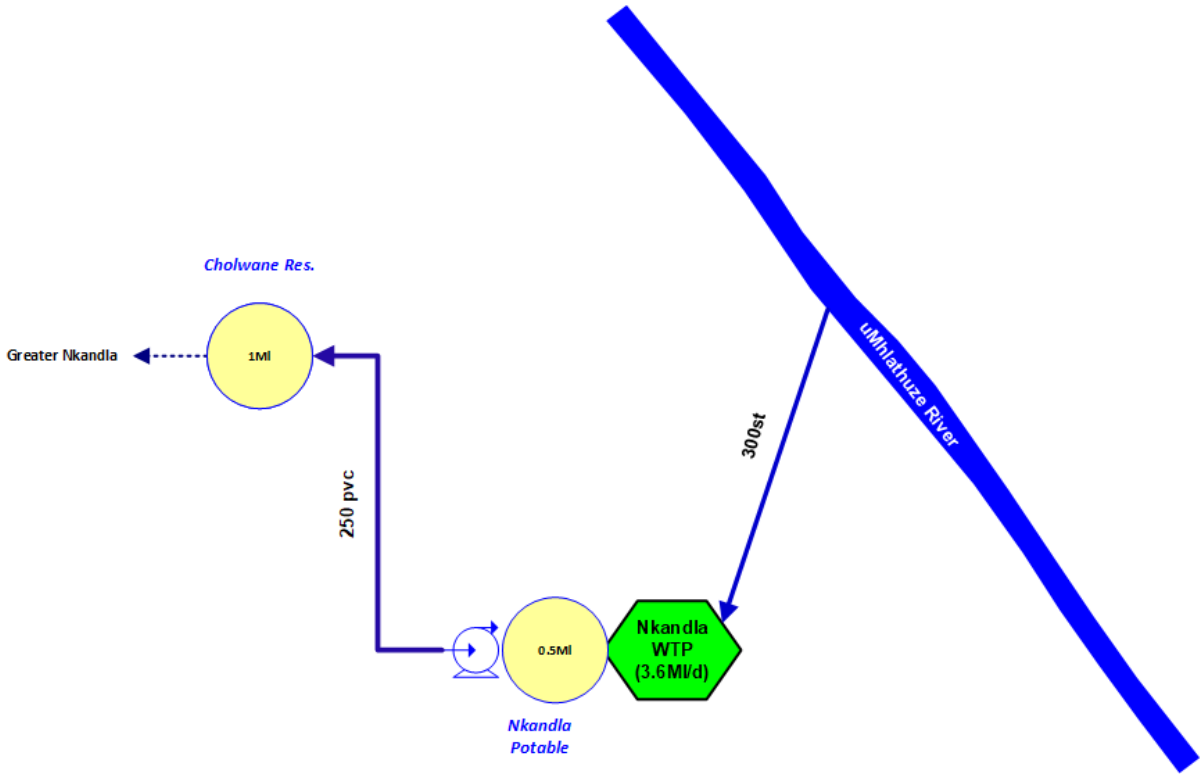



**Figure 16.10 Schematic of Nkandla WTP Supply System**

The reservoir, pump station and pipeline details are summarised in **Table 16.12**, **Table 16.13** and **Table 16.14.**

### Table 16.12 Pump Details: Nkandla WTP Supply System

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Nkandla Pump Station | 2 | 1 | KSB WKLn 100/7 | WTP | Cholwane | 139 | 147 | 3.12 |

### Table 16.13 Pipeline Details: Nkandla WTP Supply System

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Raw Water | Abstraction | WTP | 0.6 | 300 | Steel | 9.2[1] | 19 |
| uMhlathuze | Nkandla Bulk | WTP | Cholwane | 6.4 | 250 | uPVC | 6.4[1] | 19 |

[1]Based on a velocity of 1.5m/s

### Table 16.14 Reservoir Details: Nkandla WTP Supply System

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | Nkandla WTP | Nkandla Potable | 0.5 | Clear Well | 873 | 868 |
| uMhlathuze | Cholwane | Cholwane Reservoir | 1 | Balancing | 1146 | 1141 |

## (c) Middledrift Water Treatment Plant and Supply System

The Goedertrouw Transfer Scheme abstracts water from the left bank of the uThukela River (**Figure** 16.11). The Madungela High Lift Pumpstation (**Figure 16.14**) transfers water across the catchment into the uMhlathuze catchment. Raw water for the Middledrift WTP is sourced from the Goedertrouw Transfer Pipeline, downstream of the second raw water pumpstation.

The Middledrift WTP is at the Middledrift village and supplies the village and the surrounding villages up to Msobotsheni in the north east and Ntingwe in the south. The Middledrift WTP is shown in **Figure** 16.12 and **Figure 16.13** and the supply system is shown in **Figure 16.15**.


**Figure 16.11 Goedertrouw Transfer Abstraction Works.**

Figure 16.12 Aerial Photo of Middledrift WTP


Figure 16.13 Photo of Middledrift WTP Clarifiers


**Figure 16.14 Madungela High Lift Pump Station**

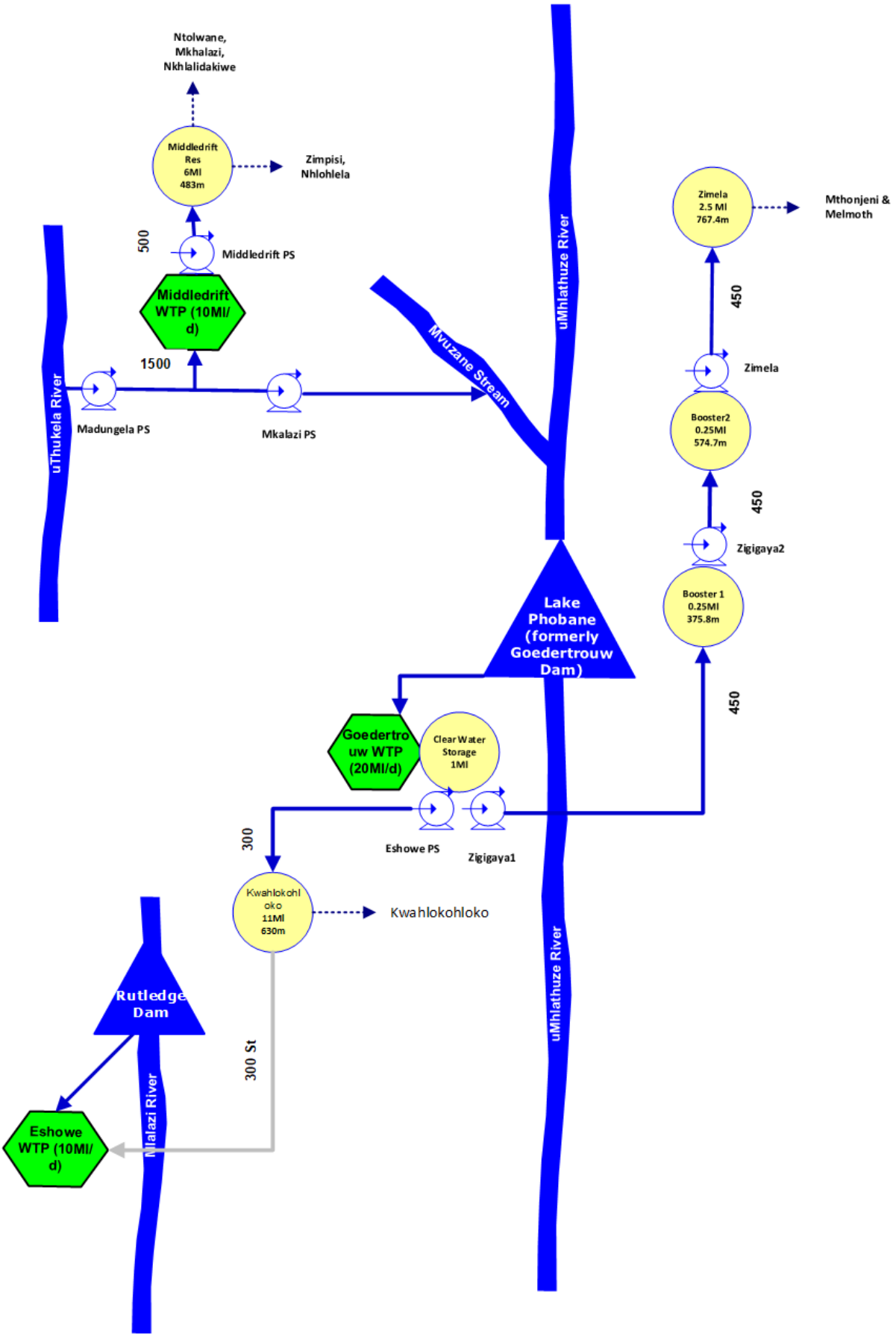



**Figure 16.15 Schematic of Central uMhlatuze System**

The Middledrift WTP is a conventional treatment plant comprising the following process components:

(i) Flocculation channels: The raw water is pumped from the uThukela Transfer Scheme abstraction works with the chemicals added as the water flows into the flocculation channels, where coagulation after polyelectrolyte dosing takes place, to form the flocs.

(ii) Clarification (sedimentation) tanks: The flocs that have formed in the flocculation channels are settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to sludge lagoons where the sludge is dried.

(iii) Rapid Gravity Sand Filtration: The clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.

(iv) Chorine contact tank: The filtered water is stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in the Middledrift supply area.

The reservoirs pump station and pipeline details related to the Middledrift Supply Scheme are summarised in **Table 16.16**, **Table 16.17** and **Table 16.18.**

## Table 16.15 Characteristics of the Middledrift WTP

| | |
|---|---|
| **WTP Name:** | Middledrift WTP |
| **System:** | Middledrift Bulk Supply System |
| **Maximum Design Capacity:** | 10 Mℓ/day |
| **Current Utilisation (January 2020):** | 6.5 Mℓ/day |
| **Raw Water Storage Capacity:** | 5 Mℓ |
| **Raw Water Supply Capacity:** | 10 Mℓ |
| **Pre-Oxidation Type:** | None |
| **Primary Water Pre-Treatment Chemical:** | Chlorine Gas |
| **Total Coagulant Dosing Capacity:** | Aluminium sulphate - 12mg/l<br>U3500 - 2mg/l |
| **Rapid Mixing Method:** | Two static inline mixers |
| **Clarifier Type:** | Clarifloculators with paddle mixers and scrapers |
| **Number of Clarifiers:** | 2 |
| **Total Area of all Clarifiers:** | 52.8 $m^2$ |
| **Total Capacity of Clarifiers:** | 156 $m^3$ |
| **Filter Type:** | Rapid Gravity Sand Filters |
| **Number of Filters:** | 5 |
| **Filter Floor Type** | Suspended floor slap (CADAR GRC Monolithic flat panel) with underfloor drainage. |
| **Total Filtration Area of all Filters** | 94 $m^2$ |
| **Total Filtration Design Capacity of all Filters:** | 469 $m^3$/hour |
| **Total Capacity of Backwash Water Tanks:** | 1.25 Mℓ - water obtained from Clear water reservoir |
| **Total Capacity of Sludge Treatment Plant:** | 1296 kℓ |
| **Capacity of Used Washwater System:** | 1296 kℓ - Included in the Sludge Lagoons |
| **Primary Post Disinfection Type:** | Chlorine gas |
| **Disinfection Dosing Capacity:** | 5mg/ℓ |
| **Disinfectant Storage Capacity:** | 1.25 Mℓ Clear water reservoir |
| **Total Treated Water Storage Capacity:** | 1.25 Mℓ Clear water reservoir |

### Table 16.16 Pump Details: Middledrift WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Madungela Transfer Ph1 | 2 | 0 | Sulzer SM 302.640 | Abstraction | Umkhalazi PS | 230 | 254 | 86.4 |
| uMhlathuze | KCDM Transfer Pumps | 1 | 1 | KSB - WKn 150/6 | Abstraction | WTP | 233 | 270 | 5.7 |
| uMhlathuze | Middledrift | 1 | 1 | Grundfos NK 200-450/435 | WTP | Middledrift Command | 61.6 | 70 | 10.3 |

### Table 16.17 Pipeline Details: Middledrift WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Raw Water Transfer[1] | Thukela River | Middledrift | 12.6 | 1500 | Steel | 86.4 | 22 |
| uMhlathuze | Supply to WTP | Transfer take-off | Middledrift WTP | 0.16 | 500 | DI | 25 | 7 |
| uMhlathuze | Middledrift Res supply | Middledrift WTP | Middledrift Command | 0.5 | 500 | DI | 25 | 7 |

[1] This pipeline is the raw water transfer to Goedertrouw Dam.

### Table 16.18 Reservoir Details: Middledrift WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | WTP | Middledrift Command | 6.0 | Balancing | 487.7 | 480.5 |

## (d) Goedertrouw Water Treatment Plant and Supply System

The Goedertrouw Dam remains the most viable water source to the Greater Mthonjaneni, Kwahlokohloko and Eshowe supply areas. Abstraction from the dam is via an existing 1.8 m diameter steel pipe to the WTP from where potable water is distributed to pump stations serving the north and south supply areas.

The Goedertrow Dam is on the uMhlatuze River and the yield is augmented by an inter basin transfer from the uThukela River. Water abstracted from the uThukela River is transferred to the Mhlatuze catchment upstream of Goedertrouw Dam. During the drought of 1994 an emergency augmentation scheme was put in place (commissioned in 1997) that has the capacity to deliver 37 million $m^3$/annum (1.2$m^3$/s) to the Mvuzane stream, a tributary of the Mhlatuze River.

The emergency scheme includes a second high-lift pump-station (Mkhalazi) at the end of the 1 500 mm pipeline, to pump the water over the watershed, through an extra rising main and gravity main.

A 450 mm diameter ductile iron rising main from the new Goedertrouw WTP at Goedertrouw Dam to a new 2.5Mℓconcrete reservoir and three pump stations (Zigigaya Booster 1, Zigigaya Booster 2 and Zimela Booster). The system supplies Greater Mthonjaneni.

The WTP also supplies south via a 300 mm pipeline (previously a raw water pipeline from Goedertrouw Dam) to Kwahlokohloko. The pipeline extends to Eshowe but this portion is not operational.

A schematic of the Goedertrouw WTP Supply System is shown in Figure 16.15**.**

The reservoir, pump station and pipeline details are summarised in **Table 16.20**, **Table 16.21** and **Table 16.22**.

The Goedertrouw WTW is a conventional treatment plant comprising the following process components:

(i) *Flocculation channels*: Raw water is pumped from the Goedertrouw Dam into flocculation channels where polyelectrolyte dosing takes place, resulting in coagulation to form the flocs.
(ii) *Clarification (sedimentation) tanks*: The flocs that have formed in the flocculation channels are then settled in the sedimentation tanks under gravity. The settled sludge is removed by frequent de-sludging of the tanks and sent to sludge lagoons where the sludge is dried while supernatant water is discharged back into the river. The plant was not designed for recycling of wastewater.
(iii) *Rapid Gravity Sand Filtration*: Clarified water is then filtered through a set of rapid gravity sand filters as a final polishing before chlorination of the treated water.
(iv) *Chorine contact tank*: Filtered water is then stored in the chorine contact tanks where chlorination takes place before pumping the water to the command reservoirs in Mthonjaneni for distribution. (Water for Africa 2011: 18)

**Figure 16.16 Goedertrouw WTP.**

## Table 16.19 Characteristics of the Goedertrouw WTP

| | |
|---|---|
| **WTP Name:** | Goedertrouw WTP |
| **System:** | Goedertrouw Bulk Supply System |
| **Maximum Design Capacity:** | 20 Mℓ/day |
| **Current Utilisation (January 2020):** | 14 Mℓ/day |
| **Raw Water Storage Capacity:** | 0 |
| **Raw Water Supply Capacity:** | 25 Mℓ/day |
| **Pre-Oxidation Type:** | None |
| **Primary Water Pre-Treatment Chemical:** | Rheofloc 523 for coagulation |
| **Total Coagulant Dosing Capacity:** | 2 * 4 ℓ/hr |
| **Rapid Mixing Method:** | Unknown |
| **Clarifier Type:** | Sedimentation Tanks |
| **Number of Clarifiers:** | 2 |
| **Total Area of all Clarifiers:** | 630 $m^2$ |
| **Total Capacity of Clarifiers:** | 20 Mℓ/day |
| **Filter Type:** | Rapid Gravity Sand Filtration |
| **Number of Filters:** | 5 |
| **Filter Floor Type** | Unknown |
| **Total Filtration Area of all Filters** | 125 $m^2$ |
| **Total Filtration Design Capacity of all Filters:** | 20 Mℓ/day |
| **Total Capacity of Backwash Water Tanks:** | 1 Mℓ |
| **Total Capacity of Sludge Treatment Plant:** | No Plant- 3 Ponds |
| **Capacity of Used Washwater System:** | N/A |
| **Primary Post Disinfection Type:** | Chlorine Gas |
| **Disinfection Dosing Capacity:** | 1.5 mg/ℓ |
| **Disinfectant Storage Capacity:** | 4 * 1 Tonne |
| **Total Treated Water Storage Capacity:** | 1 Mℓ |

## Table 16.20 Pump Details: Goedertrouw WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| Mthonjaneni | Zigigaya Booster 1 | 1 | 1 | KSB WKLn 150/5 | Goedertrouw WTP | Zigigaya 1 | 202 | 211 | 6.7 |
| Mthonjaneni | Zigigaya Booster 2 | 1 | 1 | KSB WKLn 150/5 | Zigigaya 1 | Zigigaya 2 | 195 | 211 | 6.7 |
| Mthonjaneni | Zimela | 1 | 1 | KSB WKLn 150/5 | Zigigaya 2 | Zimela Res | 198 | 211 | 6.7 |
| Kwahlokhloko | Eshowe | 0 | 1 | KSB MTC D 100 | Goedertrouw WTP | Kwahlokohloko Res | 450 | 420 | 4.2 |

## Table 16.21 Pipeline Details: Goedertrouw WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Mthonjaneni Bulk | WTP | Zigigaya Booster 1 | 2.9 | 450 | Ductile Iron | 6.72 | 10 |
| uMhlathuze | Mthonjaneni Bulk | Zigigaya Booster 1 | Zigigaya Booster 2 | 3.4 | 450 | Ductile Iron | 6.72 | 10 |
| uMhlathuze | Mthonjaneni Bulk | Zigigaya Booster 2 | Zimel2 Res | 3.6 | 450 | Ductile Iron | 6.72 | 10 |
| uMhlathuze | Kwahlokohloko Bulk | WTP | Kwahlokohloko | 10 | 300 | Steel | 9.2[1] | |

[1]Capacity based on 1.5m/s velocity

### Table 16.22 Reservoir Details: Goedertrouw WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | Goedertrouw WTP | Goedertrouw Potable | 1 | Balancing | 163 | 160 |
| uMhlathuze | Zigigaya | Zigzag 1 | 0.25 | Pump Suction Storage | 375.8 | 373 |
| uMhlathuze | Zigigaya | Zigzag 2 | 0.25 | Pump Suction Storage | 574.7 | 571 |
| uMhlathuze | Zimela | Zimela Reservoir | 2.5 | Distribution | 767.39 | 762 |

## (e) Eshowe Water Treatment Plant and Supply System

The Eshowe Water Supply Scheme comprises of one main treatment works namely the Eshowe town WTW. The Eshowe WTW abstracts raw water from the Rutledge Dam through a raw water pumping station at the outlet works of the dam. The supply from the dam to the treatment plant is through a 1100mm diameter steel pipeline. The Ruthledge Dam is augmented with raw water from the Eshlazi Dam, which is itself augmented from the Goedertrouw Dam. Rutledge Dam and Eshlazi Dam have a combined firm yield of 3.2 Mℓ/day. Therefore, augmentation from Goedertrouw Dam will have to continue to supply in order to maintain sufficient raw water supply.

The treatment works is located within the town of Eshowe and supplies the existing domestic users in Eshowe and the surrounding communities which is made up of Several formal and informal townships in Eshowe and rural villages. The town also has several small industries as well as commercial concerns, businesses and institutions such as the hospital, schools and municipal buildings.

The treated water from the Eshowe WTW is pumped from the clearwater tanks to service reservoirs in Eshowe town and surrounding villages to the west and east of the town before distribution to the users.

## (f) Ngwelezane Water Treatment Plant and Supply System (CoU)

Ngwelezane and Madlebe towns are supplied from the Ngwelezane WTP. Ngwelezane WTP abstracts water from the Mhlathuze River upstream of the Mhlathuze Weir on the border with uMlalazi LM. The communities are supplied via three (3) reservoirs located on the edge of town. The WTP has a capacity of 8 Mℓ/day and operates at full capacity.


**Figure 16.17 Ngwelezane WTP.**

The Ngwelezane WTP and Supply System is shown in **Figure 16.18.**

Water is abstracted from the left bank of the uMhlathuze River and pumped to the WTP located on the river bank. A 250 mm diameter pipeline from the works feeds the 13.4 Mℓ Ngwelezane Bulk Reservoir. The reservoir supplies the Ngwelezane community.

The reservoir, pump station and pipeline details are summarised in **Table 16.24, Table 16.25** and **Table 16.26.**

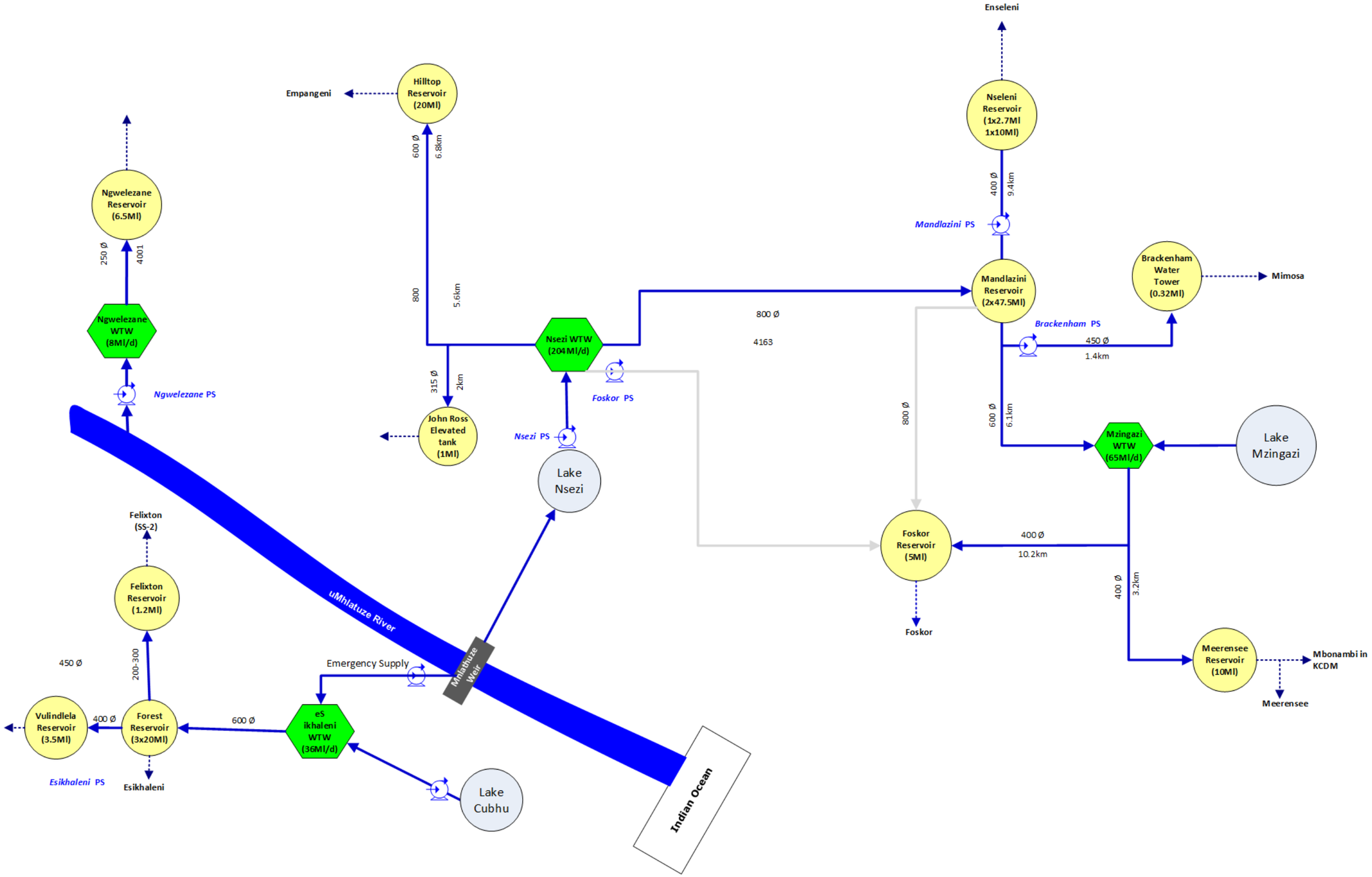



Figure 16.18 Schematic of CoU System

## Table 16.23 Characteristics of the Ngwelezane WTP

| | |
|---|---|
| **WTP Name:** | Ngwelezane WTP |
| **System:** | Ngwelezane Bulk Supply System |
| **Maximum Design Capacity:** | 8 Mℓ/day stated (possibly up to 10 ml/day) |
| **Current Utilisation (January 2020):** | Unknown |
| **Raw Water Storage Capacity:** | River Abstraction |
| **Raw Water Supply Capacity:** | 8 Ml/day |
| **Pre-Oxidation Type:** | Flocculation channels |
| **Primary Water Pre-Treatment Chemical:** | Lime |
| **Total Coagulant Dosing Capacity:** | Unknown |
| **Rapid Mixing Method:** | Unknown |
| **Clarifier Type:** | n/a |
| **Number of Clarifiers:** | n/a |
| **Total Area of all Clarifiers:** | Horizontal Flow Sedimentation tanks 14 x 7.5 m |
| **Total Capacity of Clarifiers:** | Two No's with total capacity of +/- 10-11.5 ml/day |
| **Filter Type:** | Rapid Gravity filters |
| **Number of Filters:** | 3 no's |
| **Filter Floor Type** | Unknown |
| **Total Filtration Area of all Filters** | 5m x 4 m x 3 no's = 60 sqm |
| **Total Filtration Design Capacity of all Filters:** | 8 Ml/day |
| **Total Capacity of Backwash Water Tanks:** | Unknown |
| **Total Capacity of Sludge Treatment Plant:** | Sludge Lagoons |
| **Capacity of Used Washwater System:** | Unknown |
| **Primary Post Disinfection Type:** | Chlorine Gas |
| **Disinfection Dosing Capacity:** | Unknown |
| **Disinfectant Storage Capacity:** | Unknown |
| **Total Treated Water Storage Capacity:** | Ngwelezana complex 2x1.68 Ml, 1 x 6.5 Ml, 1 x 3.5 Ml |

### Table 16.24 Pump Details: Ngwelezane WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Ngwelezane Abstraction | | | | uMhlatuze River | Ngwelezane WTP | 8 | | |
| uMhlathuze | Ngwelezane | 4 | 0 | WKLN 125/5 | Ngwelezane WTP | Ngwelezane Res | 175 | 160 | 4.8 |

### Table 16.25 Pipeline Details: Ngwelezane WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Ngwelezane Bulk | Ngwelezane WTP | Ngwelezane Res | 4 | 250 | | 6.4 | |

### Table 16.26 Reservoir Details: Ngwelezane WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | Ngwelezane | Ngwelezane | 13.4 | | 115 | 110 |

## (g) eSikhaleni Water Treatment Plant and Supply System (CoU)

The eSikhaleni WTP sources water from Lake Cubhu and is supplemented from the Mhlathuze Weir. It supplies Esikaleni and Vulindlela.

An emergency pipeline exists between the Mhlatuze Weir and the eSikhaleni WTP for use during times when the Lake Cubhu water level is too low for abstraction. The lake is generally preferred as a water source for the municipality, since the river abstraction requires pumping, which has cost implications. The WTP has a capacity of 36 Mℓ/day.

Historically eSikhaleni relied completely on Lake Cubhu as a source. Serious problems were, however, experienced during the 1992/94 drought, with low lake levels and an augmented supply from the Mhlathuze River was implemented. The scheme from the Mhlathuze River was implemented as part of the Iscor Mining water supply scheme, and was completed during May/June 2001. This system has a capacity of 34 Mℓ/day.

Due to the decreasing lake levels, as from August 2014, eSsikhaleni WTP was supplemented with 7.5Mℓ/day (raw water from Mhlathuze Water Weir Pump Station) and this volume was increased gradually to a maximum system capacity of 30Mℓ/day in January 2015.

Figure 16.19 eSikhaleni WTP.

The eSikhaleni WTP Supply System is shown in **Figure 16.18** and the details of the WTP is shown in **Table 16.27.** The reservoir, pump station and pipeline details are summarised in **Table 16.29** , **Table 16.30** and **Table 16.30.**

## Table 16.27 Characteristics of the eSikhaleni WTP

| | |
|---|---|
| **WTP Name:** | eSikhaleni WTP |
| **System:** | eSikhaleni Bulk Supply System |
| **Maximum Design Capacity:** | 36 Mℓ/day |
| **Current Utilisation (January 2020):** | 36 Ml/day |
| **Raw Water Storage Capacity:** | Lake Cubu |
| **Raw Water Supply Capacity:** | 36 Ml/day |
| **Pre-Oxidation Type:** | Flocculation channels |
| **Primary Water Pre-Treatment Chemical:** | Lime |
| **Total Coagulant Dosing Capacity:** | Unknown |
| **Rapid Mixing Method:** | Concrete inlet chamber |
| **Clarifier Type:** | 4 No's Horizontal flow tanks 11x38m each |
| **Number of Clarifiers:** | 4 |
| **Total Area of all Clarifiers:** | 1675 sqm |
| **Total Capacity of Clarifiers:** | 36 ml/day |
| **Filter Type:** | Rapid gravity ( dual media) |
| **Number of Filters:** | 8 Rapid Gravity filters |
| **Filter Floor Type** | False Floor |
| **Total Filtration Area of all Filters** | 8m x 5 m x 8No's 40 sqm each |
| **Total Filtration Design Capacity of all Filters:** | 36 Ml/day |
| **Total Capacity of Backwash Water Tanks:** | Unknown |
| **Total Capacity of Sludge Treatment Plant:** | Sludge Lagoons |
| **Capacity of Used Washwater System:** | Unknown |
| **Primary Post Disinfection Type:** | Chlorine Gas |
| **Disinfection Dosing Capacity:** | Unknown |
| **Disinfectant Storage Capacity:** | Unknown |
| **Total Treated Water Storage Capacity:** | Esikhaleni = 3 x 20 Ml/day , |

### Table 16.28 Pump Details: eSikhaleni WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Esikhaeleni High Lift Pump station | 3 | 1 | Sulzer Weir, Centrifugal Pumps | Tratment Plant | Storage Reservoir | 125 | 130 | 13 |

### Table 16.29 Pipeline Details: eSikhaleni WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | | eSikhaleni WTP | Forrest Reservoir | 9.3 | 600 | | 34 | 19 |

### Table 16.30 Reservoir Details: eSikhaleni WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | | Forrest Reservoir | 60 | Balancing | 135 | 130 |

## (h) Nsezi Water Treatment Plant and Supply System (CoU)

The primary supply for Nsezi WTP is the Nsezi Lake. The yield is supplemented by transfers from the Mhlathuze River at Mhlathuze Weir (**Figure 16.20**). Mhlathuze Weir relies on releases from Goedertrouw Dam (owned and operated by DWS). Water is released from the dam and flows for about 90 km to a weir owned and operated by Mhlathuze Water. From the weir, water is pumped into Lake Nsezi, which acts as balancing storage for Mhlathuze Water's Nsezi WTP. The WTP was recently upgraded and now has a capacity of 204Mℓ/day.

This WTP is the most significant in CoU and supplies Empangeni, Richards Bay, and Ngwelezane. An 800 mm diameter pipeline, from the WTP, supplies the 20 Mℓ Hilltop Reservoir which supplies Empangeni. There is also an 800 mm diameter pipeline supplying Mandlazini Command Reservoir that serves Richards Bay.

**Figure 16.20 uMhlatuze Weir.**

**Figure 16.21 Nsezi WTP.**

The Nsezi WTP Supply System is shown in **Figure 16.18** and details of the WTP is shown in **Table 16.31**.

The reservoir, pump station and pipeline details are summarised in **Table 16.32**, **Table 16.33** and **Table 16.34**.

### Table 16.31 Characteristics of the Nsezi WTP

| | |
|---|---|
| **WTP Name:** | Nsezi WTP |
| **System:** | Nsezi Bulk Supply System |
| **Maximum Design Capacity:** | 204 Mℓ/day |
| **Current Utilisation (January 2020):** | 190 Mℓ/day |
| **Raw Water Storage Capacity:** | Lake Nsezi, Mhlthuze River, Goedertrouw system |
| **Raw Water Supply Capacity:** | 333 Ml/day |
| **Pre-Oxidation Type:** | Unknown |
| **Primary Water Pre-Treatment Chemical:** | Unknown |
| **Total Coagulant Dosing Capacity:** | Alum and Polyelectrolyte |
| **Rapid Mixing Method:** | Concrete Flash mixing chamber & Flocculation conditioning |
| **Clarifier Type:** | 1 no's 34 m dia , 2 no's 48 m dia |
| **Number of Clarifiers:** | 3No's |
| **Total Area of all Clarifiers:** | 3970 sqm |
| **Total Capacity of Clarifiers:** | 210 Ml/day |
| **Filter Type:** | Degramont V type – Rapid Gravity |
| **Number of Filters:** | 12 filters |
| **Filter Floor Type** | Unknown |
| **Total Filtration Area of all Filters** | 17.5 m x 8 m x 12 No's = 1680 sqm |
| **Total Filtration Design Capacity of all Filters:** | 202 Ml/day |
| **Total Capacity of Backwash Water Tanks:** | Unknown |
| **Total Capacity of Sludge Treatment Plant:** | Unknown |
| **Capacity of Used Washwater System:** | Unknown |
| **Primary Post Disinfection Type:** | Chlorine Gas and Caustic Soda |
| **Disinfection Dosing Capacity:** | Unknown |
| **Disinfectant Storage Capacity:** | Unknown |
| **Total Treated Water Storage Capacity:** | Unknown |

### Table 16.32 Pump Details: Nsezi WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Empangeni | 2 | 1 | | Nsezi | Empangeni/Hillview | 120 | 158 | 52 |

### Table 16.33 Pipeline Details: Nsezi WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Mandlazini Supply | Nsezi WTP | Pierce Cres. Res. | 5.7/1.8 | 800/600 | Steel | 65/37 | |
| uMhlathuze | Empangeni Supply | T-off | Hilltop Res. | 1.5 | 600 | Steel | 37 | |

### Table 16.34 Reservoir Details: Nsezi WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | Hilltop | Hilltop Reservoir | 60 | Distribution | 135 | 130 |

## (i)Mzingazi Water Treatment Plant and Supply System (CoU)

Mzingazi WTP has a capacity of 65 Mℓ/day. Raw water is abstracted from Lake Mzingazi, which is then treated and distributed into Richards Bay and the industrial areas. The industrial area within the city of Richards Bay includes the Alton area, where Mondi, Hillside and Bayside Aluminium and Foskor are located. The residential suburbs include Meerensee, Arboretum and Veld en Vlei and the commercial/ light-industrial centre. Both residential and commercial / light industry, are supplied from the Mzingazi WTP, and supplemented, when necessary, from the Nsezi WTP. The rural town of Nseleni is also supplied via this scheme.

Mzingazi WTP supplies two command reservoirs, namely Mandlazini and Meerensee Reservoirs.

The Mzingazi WTP Supply System is shown in **Figure 16.18** and details of the WTP is shown in **Table 16.35**.

The reservoir, pump station and pipeline details are summarised in **Table 16.36**, **Table 16.37** and **Table 16.38**.

**Figure 16.22 Mzingazi WTP**

## Table 16.35 Characteristics of the Mzingazi WTP

| | |
|---|---|
| **WTP Name:** | Mzingazi WTP |
| **System:** | Mzingazi Bulk Supply System |
| **Maximum Design Capacity:** | 65 Mℓ/day |
| **Current Utilisation (January 2020):** | |
| **Raw Water Storage Capacity:** | Mzingazi Lake 164 sq/km 47.6 milj cubic meters per year |
| **Raw Water Supply Capacity:** | The estimated duty of the existing pumps is 1300m³/h at a head of 13.5m per pump (3 pumps) |
| **Pre-Oxidation Type:** | Unknown |
| **Primary Water Pre-Treatment Chemical:** | Lime Dosing & Pre-chlorination |
| **Total Coagulant Dosing Capacity:** | Unknown |
| **Rapid Mixing Method:** | Unknown |
| **Clarifier Type:** | N/A |
| **Number of Clarifiers:** | N/A |
| **Total Area of all Clarifiers:** | N/A |
| **Total Capacity of Clarifiers:** | N/A |
| **Filter Type:** | Rapid gravity ( dual media) |
| **Number of Filters:** | 8 Rapid Gravity filters |
| **Filter Floor Type** | False Floor |
| **Total Filtration Area of all Filters** | 9m x 7.5 m x 8No's = 67.5 sqm. each |
| **Total Filtration Design Capacity of all Filters:** | 36 Ml/day |
| **Total Capacity of Backwash Water Tanks:** | Unknown |
| **Total Capacity of Sludge Treatment Plant:** | Unknown |
| **Capacity of Used Washwater System:** | Unknown |
| **Primary Post Disinfection Type:** | Chlorine Gas |
| **Disinfection Dosing Capacity:** | Unknown |
| **Disinfectant Storage Capacity:** | Unknown |
| **Total Treated Water Storage Capacity:** | Mandlazini 2 x 47.5 Ml & Meerensee 1 x 10 Ml |

### Table 16.36 Pump Details: Mzingazi WTP Supply

| System | Pump Station Name | Number of Pumps | | Pump Description | Supply From | Supply To | Static Head (m) | Duty Head (m) | Duty Capacity (Mℓ/day) |
|---|---|---|---|---|---|---|---|---|---|
| | | Number of Duty Pumps | Number of Standby Pumps | | | | | | |
| uMhlathuze | Mandlazini | 4 | 1 | Samco Vertical turbine | Mzingazi WTP | Mandlazini Res. | 54 | 60 | 27.7 |
| uMhlathuze | Meerensee | 2 | 1 | Samco Vertical turbine | Mzingazi WTP | Meerensee Res | 72 | 67 | 23.3 |

### Table 16.37 Pipeline Details: Mzingazi WTP Supply

| System | Pipeline Name | From | To | Length (km) | Nominal Diameter (mm) | Material | Capacity (Mℓ/day) | Age (years) |
|---|---|---|---|---|---|---|---|---|
| uMhlathuze | Meerensee Pipeline | Mzingazi WTP | Meerensee Res. | 3.2 | 400 | Steel | 16.3 | |
| uMhlathuze | Mandlazini Pipeline | Mzingazi WTP | Mandlazini Res. | 6.1 | 600 | Steel | 36.7 | |

### Table 16.38 Reservoir Details: Mzingazi WTP Supply

| System | Reservoir Site | Reservoir Name | Capacity (Mℓ) | Function | TWL (mASL) | FL (mASL) |
|---|---|---|---|---|---|---|
| uMhlathuze | Meerensee | Meerensee | 10 | Distribution | 51 | 47 |
| uMhlathuze | Mandlazini | Mandlazini | 95 | Distribution | 67 | 62 |

### 16.3.2 Status Quo and Limitations of the uMhlathuze System

#### (a) Nkandla Water Treatment Plant and Supply System

The WTP is currently operating at design capacity. The demand in this area is now constrained by the WTP capacity. The existing bulk treated water supply capacity is not sufficient to meet future water requirements of the Nkandla Water Supply Scheme.

Apart from the Nkandla System, there are numerous boreholes, springs and minor river abstractions that serve the Nkandla Local Municipality. These standalone schemes do not have a sustainable supply and are also an operational challenge. There is a need to consolidate these schemes into a more sustainable bulk supply system. The population in the region is projected to be 12 900 in 2050 with a total demand of 24 Mℓ/day. The current Nkandla Supply System cannot meet this demand. A new resource will have to be developed to ensure a sustainable future supply.

#### (b) Middledrift Water Treatment Plant and Supply System

The water treatment plant is operating at approximately 7 Mℓ/day. Assuming that the operational capacity is 90% of the design capacity, it means that this plant is operating at close to its operational capacity.

The supply to Middledrift WTP is heavily dependent on the operation of the Lower uThukela/Goedertrouw transfer. There is a need for a dedicated supply to this plant to alleviate this dependency. This will require new pump stations and a dedicated raw water pipeline.

KCDM is in the process of implementing secondary bulk infrastructure that relies on supply from this water treatment plant. As the supply increases, there will be a need to upgrade the bulk supply infrastructure and treatment capacity. The projected 2050 demand is expected to be approximately 20 Mℓ/day.

#### (c) Goedertrouw Water Treatment Plant and Supply System

The current utilisation of the plant is 14 Mℓ/day. The plant is approaching its capacity and will need to be upgraded. KCDM have appointed a PSP to upgrade the plant in phases to its maximum capacity of 80 Mℓ/day. The first phase, which will take the capacity to 40 Mℓ/day, is being designed and construction will likely be completed by 2025.

The Goedertrouw Supply System has three bulk supply zones. Mthonjaneni to the north is expected to have a demand of 22 Mℓ/day in 2050. The bulk infrastructure for this system has recently been completed and is adequate for the medium term demand.

The supply to the south is to Kwahlokohloko. This supplies a rudimentary level of service and Kwahlokohloko also relies on boreholes. There are plans (currently at design phase) to develop a bulk supply system from Goedertrouw WTP into Kwahlokohloko and further on to Eshowe and Gingindlovu.

## (d) Eshowe Water Treatment Plant and Supply System

The water treatment plant is currently operating at well above its treatment capacity. The reconciliation strategy for Eshowe (DWS : 2011, 20) reported at that stage that the plant was operating at approximately 7 Mℓ /day. The plant has a design capacity of about 6.8 Mℓ /day.

The existing raw water abstraction works, including the raw water pumps, has sufficient capacity to meet the hydraulic design requirements of the existing WTW.

## (e) CoU Bulk Water Supply

The WTP's in CoU are integrated and a review of the sustainable approach to bulk water supply in CoU suggests that a more optimum usage of the plants is required. This is also guided by the depletion of some of the lakes. The existing WTPs were used as the basis to establishing future water supply arrangements.

CoU currently has four (4) WTPs that are considered to be in operating condition. Nsezi WTP serves as a redundancy to Mzingazi WTP and Ngwelezane WTP by supplementing the Northern and Western areas when required. During the recent drought, in 2015, the low water levels in Lake Mzingazi, Lake Nsezi and Lake Chubu resulted in the Nsezi WTP being used to serve the aforementioned resources' supply areas. This, in reality, meant the plants were being operated as one scheme.

The Nsezi WTP is operating at 190 Mℓ/day on average. This is 95% of its capacity. There is an urgent need to upgrade the plant to reduce the risk of non-supply. This plant is a key supply to the region and serves as a back up to supply the Mzingazi Supply System which carries the risk of an erratic supply from Lake Mzingazi.

The draft Water and Waste Water Master Plan by Mhlathuze Water (2016), lists various WTP scenarios for future potable water supply to CoU based on the aforementioned relationships between the existing WTPs. These scenarios are listed in **Table 16.39.**

**Table 16.39 WTP Scenarios in CoU (uMhlathuze Water 2016).**

| Scenario | Water Treatment Plant |
|---|---|
| Scenario A | ▪ Nsezi WTP (Lake Nsezi supplemented by uMhlathuze Weir) |
| Scenario B | ▪ Nsezi WTP (Lake Nsezi supplemented by uMhlathuze Weir)<br>▪ eSikhaleni WTP (Lake Qhubu supplemented by uMhlathuze Weir) |
| Scenario C | ▪ Nsezi WTP (Lake Nsezi supplemented by uMhlathuze Weir)<br>▪ Mzingazi WTP (Lake Mzingazi)<br>▪ eSikhaleni WTP (Lake Qhubu supplemented by uMhlathuze Weir) |
| Scenario D (Status Quo) | ▪ Nsezi WTP (Lake Nsezi supplemented by uMhlathuze Weir)<br>▪ Mzingazi WTP (Lake Mzingazi)<br>▪ eSikhaleni WTP (Lake Qhubu supplemented by uMhlathuze Weir)<br>▪ Ngwelazane WTP (uMhlathuze River) |

Scenario B is considered the most likely option (UW 2016 : 42). This scenario dictates the suggested upgrades that will be required.

## (f) Ngwelezane Water Treatment Plant and Supply System

The current operation of this plant is 12 Mℓ/day (CoU IWA water balance spreadsheet, March 2020). This is well above its design capacity.

Ngwelezana WTW is very old and is experiencing many operational problems which, apart from operating above its design capacity, has the following challenges:

- Low water levels in the river resulting in insufficient flow to the intake tower;
- Variable sand and silt levels in the river. This not only results in problems at the abstraction but high turbidity levels at the plant;
- Pump damage during flooding.

Given the age of the works and the relatively small amount of water it supplies, the plans by CoU is to decommission the works and supply this system from the Nsezi WTP. There are inter-connections between these systems that will allow a quick change to introduce this operational regime. The load transfer is, however, dependant on the upgrade of the treatment capacity of the Nsezi WTP.

## (g) eSikhaleni Water Treatment Plant and Supply System

The current operation of this plant is 27 Mℓ/day (CoU IWA water balance spreadsheet, March 2020) which is 76% of its maximum operating capacity and equivalent to its design capacity.

After consolidation of the WTPs, eSikhaleni WTP will supply the northern and western areas of CoU. There is no redundancy for good operating practices such as taking filters offline for cleaning.

The plant relies on Lake Cubu, augmented by a supply from the uMhlathuze River at the Weir. There is an increased reliance on the uMhalthuze weir. This has resulted in an increased cost to produce potable water due to the pumping required.

The plant supplies the eastern portion of KCDM and the ideal solution is to load-shed this zone onto a different supply system.

## (h) Nsezi Water Treatment Plant and Supply System

The current operation of this plant is 27 Mℓ/day (CoU IWA water balance spreadsheet, March 2020) which is 76% of its maximum design capacity. This is equivalent to its design capacity.

After consolidation of the WTPs, Nsezi WTP will supply the southern areas of CoU. The Ngwelezane, eSikhaleni and Mzingazi Water Treatment Plant Supply zones are planned to eventually be supplied from Nsezi WTP. The long term demand is anticipated to be approximately 240 Mℓ/day. Included in this estimate is the supply of 90 Mℓ/day and 21 Mℓ/day to Mondi and Foskor respectively. Richards Bay Minerals utilises raw water and is excluded from these demands. It will, however, need to be considered in the resource calculations.

Nsezi is a key water treatment plant in the supply of potable water to CoU. The resource to supply this plant with adequate raw water is critical. The primary supply is from the uMhalthuze weir with the assurance of supply from Goedertrouw Dam via controlled releases. This, however, is not enough to meet the long term demands and other resources are required to augment supply to the plant. The resource options are discussed in the recommended projects section of this report. (**Section 16.5.1(e))**

## (i)Mzingazi Water Treatment Plant and Supply System

The biggest concern with regards to the Mzingazi WTP is the supply of raw water from Lake Mzingazi. During droughts, the lake level drops, resulting in very little or no water flow to the intake tower. This has a impact on the treatment capacity of the works. Historical figures indicate a reduction in capacity to zero. This occurred during the drought of 2011/12 and has since occurred more frequently. This has resulted in an increased reliance on supply from Nsezi WTP.

When there is sufficient supply from Lake Mzingazi, the plant operates at its maximimum design capacity of 65 Mℓ/day.

Because there is a low assurance of raw water supply to the plant, any upgrades to this plant is not prudent. Ultimately, this supply zone will be permanently supplied from Nsezi WTP.

# 16.4 Water Balance/Availability

Both Eshlazi and Rutledge dams operate as a unit and their combined firm yield is 1.29 million $m^3$ (3.53 Ml/day) according to a DWS (2016) report. The firm yield of the Mhlathuze System is 248 million $m^3$/annum and includes a combination of yields from Goedertrouw Dam, Coastal Lakes, tributary flows captured at the Mhlathuze weir and the existing uThukela transfer (DWS, 2020).
The DWS, 2020 report concludes that:

- The existing water resources in the Mhlathuze System are sufficient to supply demands until the year 2021 at a satisfactory assurance of supply.
- The additional water available to the system, when the Thukela transfer is increased, is equal to 45 million $m^3$/annum. This is more than the actual increased transfer volume and can only be achieved if the system is operated in an efficient manner, including leaving water in the Goedertrouw Dam and making use of tributary flows for as long as possible.
- The impact of raising Goedertrouw Dam by 2.8 m would be to add 5.8 million$^3$/annum to the system.
- Additional water resource options of a dam on the Nseleni River and an off channel dam on the Mfolozi River are viable, however, a dam on the Mhlathuzana river is not preferred from an ecological perspective.
- The existing resources available to the surrounding towns of Mtunzini and Eshowe are sufficient to supply their demands, however, the towns of Gingindlovu and Melmoth are not supplied at a satisfactory level of assurance.

The uMhalathuze Supply System consists of the Goedertrouw Dam integrated with the resources of the coastal lakes and inter-basin transfer from the uThukela catchment. The system requires future resource augmentation to meet the long-term demands. An additiontional transfer from the uThukela River and a transfer from a new dam in the Mfolozi River is proposed. The water availability in relation to the projected demand is reflected in **Figure 16.23**.

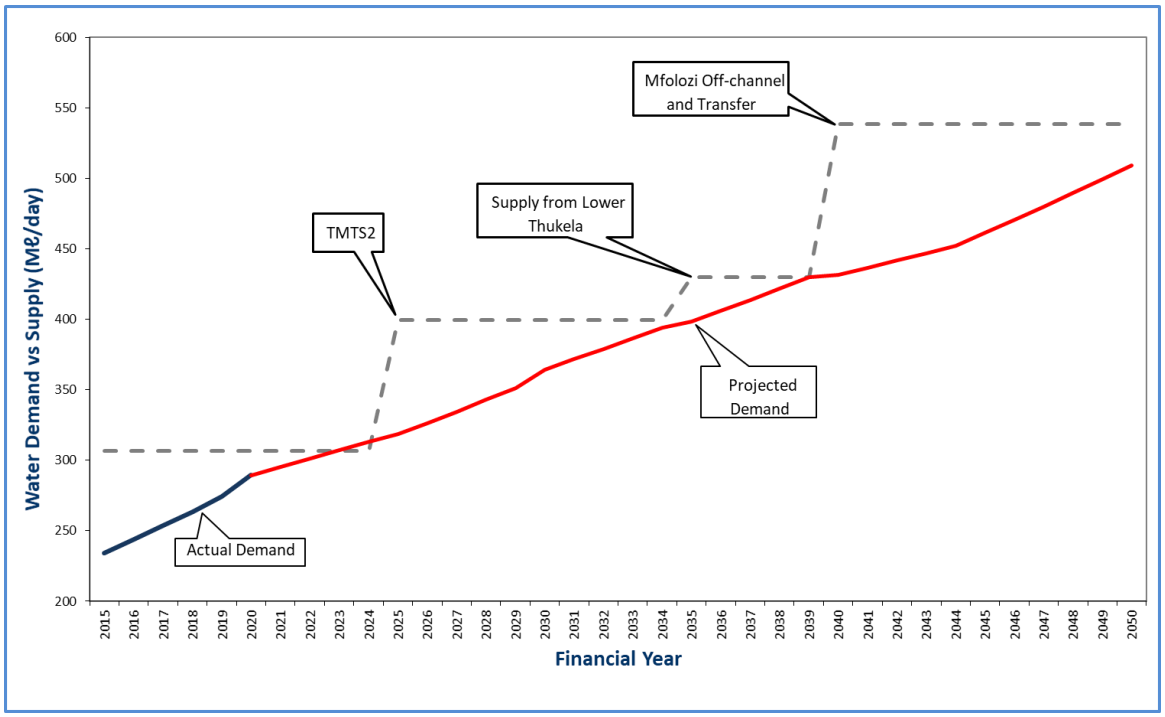



**Figure 16.23 Mhlathuze System Balance**

# 16.5 Recommendations for the uMhlathuze System

## 16.5.1 System Components

### (a) Nkandla Water Treatment Plant and Supply System

This system is constrained by the abstraction from the river. There is also limited space to expand the treatment plant. There are numerous standalone schemes and small treatment plants within the Nkandla municipal area and a regional scheme will consolidate these schemes.

The Universal Access Plan Phase 2 (UW 2016), recommended a new supply from Dundee or developing a new dam on the Nsuze River. A feasibility study is proposed to determine the best option to supply the Nkandla Local Municipality.

### (b) Middledrift Water Treatment Plant and Supply System

The current supply utilises the transfer pipeline to Goedertrouw Dam. Operationally, it is preferred that there is a dedicated supply to the plant so that there is no conflict with the Goedertrouw transfer operational regime.

This will require an abstraction works on the uThukela River, a pump station and a 500 mm diameter rising main. The WTP should be upgraded to 25 Mℓ/day. This treatment plant would effectively be a duplication of the current process infrastructure. These upgrades are currently in design stage.

### (c) Goedertrouw Water Treatment Plant and Supply System

To meet the future 80 Mℓ/day demand, the WTP should be upgraded by 60 Mℓ/day to a total capacity of 80 Mℓ/day. These upgrades should be implemented incrementally in 20 Mℓ/day modules. The first phase is being designed and should be implemented as soon as possible so that it can supply Eshowe. The bulk infrastructure to Kwahlokohloko and Mtanjoneni is in place for the increased treatment requirements.

The yield of the dam will have to be increased through a duplication of the inter basin transfer from the uThukela River. The Goedertrouw Dam is the storage for the supply to City of uMhlathuze through controlled releases for abstraction at uMhlathuze Weir. Two interventions are recommended:

- Duplication of the inter-basin transfer from 100 Mℓ/day to 200 Mℓ/day.
- Raising the Dam Wall. This involves a 2.8 m raising of the dam wall by building a concrete wave wall on the existing earthfill dam wall, and increasing the capacity of the spillway through a labyrinth spillway configuration (DWS, Reconciliation Strategy 2015).

### (d) Eshowe Water Treatment Plant and Supply System

The Eshowe WTP is operating at its capacity. Raw water from Rutledge Dam is constrained and additional raw water will have to come from Goedertrouw Dam. KCDM has plans to ultimately decommission this plant and supply Eshowe from Goedertrouw WTP.

It is a possibility to supply Eshowe and Gingindlovu by extending the Lower Thukela pipeline to feed into the Eshowe WTP clear wells. This will shift the demand from Goedertrouw Dam and, therefore, the uMhlathuze catchment.

## (e) Supply to CoU

Future configuration of water supply to the CoU is shown in **Figure 16.24**. With the potential consolidation of the WTP's, there is a need to review and develop further resources. CoU commissioned a Water Recourses Study in 2020 and the following resource augmentations are mooted (CoU 2020: 31):

- Increased capacity of the Thukela-Mhlathuze Transfer Scheme.
- Kwesibomvu Dam on the Mfolozi River. Due to the very high ecological impacts that this scheme would have, it was regarded as preferable to consider an off-channel dam instead.
- Off-channel transfer scheme from the Mfolozi River.
- Coastal pipeline from the lower uThukela River.
- Desalination of seawater.

**Off channel storage dam:** This would involve pumping from a weir on the Mfolozi River to an off-channel earthfill dam at the Nkatha Pan. The scheme would transfer water to Nsezi WTP and provide a regional water supply to Mtubatuba and other small towns.

The proposed use of only Nsezi WTP and eSikhaleni WTP, to meet 2035 potable water demands, means that the four (4) existing water schemes will have to be consolidated into two (2) future schemes, namely the Southern Scheme and Nsezi Scheme. The Southern Scheme boundary remains unchanged. The Nsezi Scheme is a consolidation of the existing Western, Empangeni and Northern Scheme.

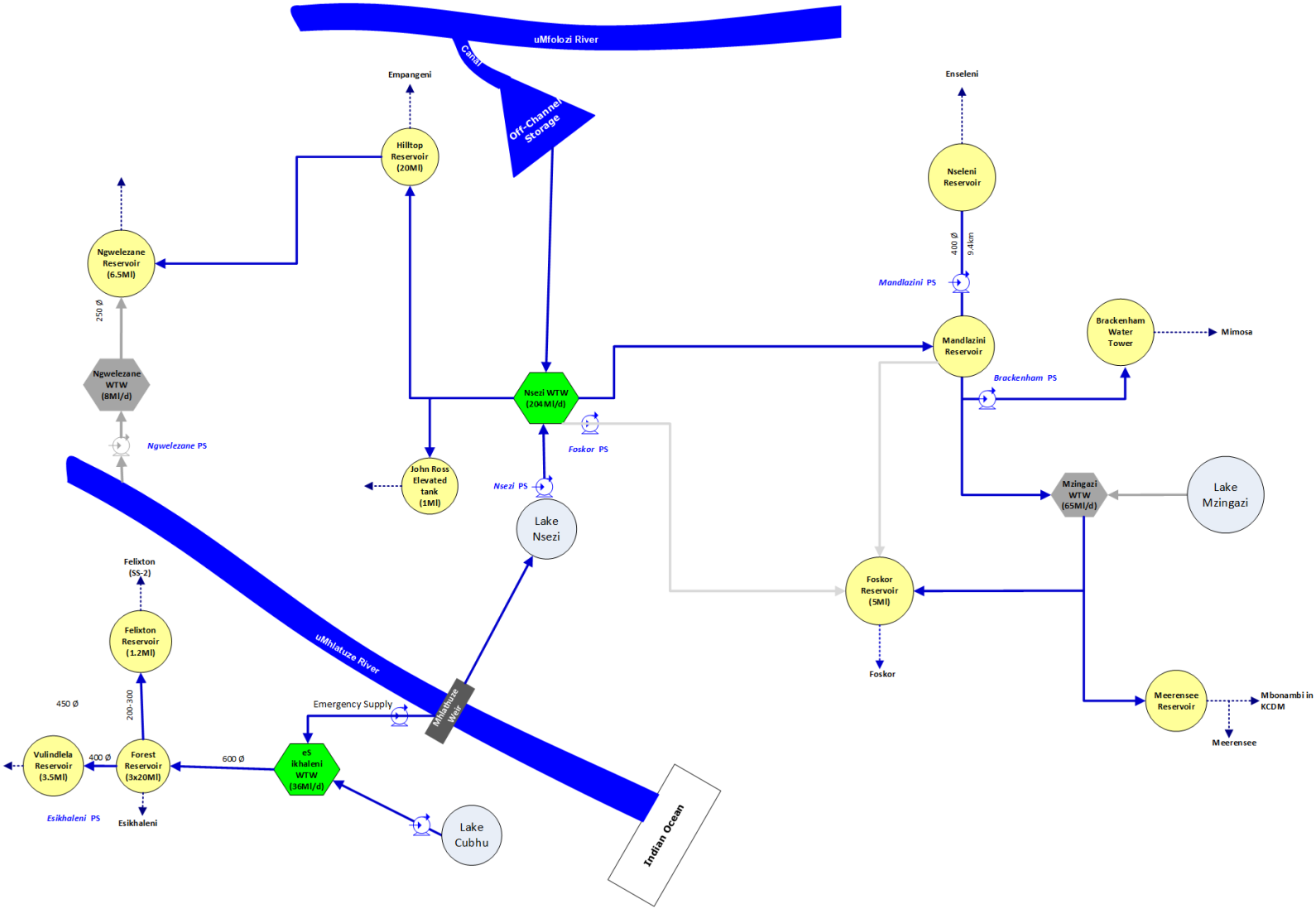



**Figure 16.24 Future Bulk Scenario for CoU**

## (f) eSikhaleni Water Treatment Plant and Supply System

The existing design capacity for eSikhaleni WTP is 36 Mℓ/day. The potable water demand projected to 2035 is estimated at 48 – 56 Mℓ/day. There is thus a shortfall of 13 – 21 Mℓ/day of treatment capacity when comparing the future demand against the existing supply capacity. Lake Chubu is unlikely to meet this demand and given its dramatic reduction in yield, during droughts, abstraction from uMhaluze Weir should become a permanent solution. This will require upgrades to the abstraction works, pumps and pipelines.

Forrest Reservoirs function as balancing and reticulation reservoirs. The current collective capacity of these reservoirs equates to 60 Mℓ (3 x 20Mℓ). Based on a 48 hour storage capacity, the future potable water storage capacity is estimated to be between 67 – 80 Mℓ. An additional 20Mℓ storage capacity at Forrest Reservoirs is proposed.

It is a possibility to supply the eSikhaleni supply system by extending the Lower Thukela pipeline to feed into the eSikhaleni WTP clear wells. This will load shift the demand from Goedertrouw Dam and thus the uMhlathuze catchment.

## (g) Nsezi Water Treatment Plant and Supply System

Development of the uMfolozi off-channel dam is required to meet future resource deficits. For the future abstraction required from Mhlathuze Weir, an upgrade to the abstraction works and raw water pipelines is required.

The existing design capacity of Nsezi WTP is 204 Mℓ/day. An upgrade of 100 – 145 Mℓ/day will be required to meet the future demand for the Northern, Empangeni and Western Scheme. The upgrade will require the following:

- New 48 m diameter clarifier;
- Four new filters;
- Minor refurbishment to DAF units;
- DAF bypass;
- Sludge handling facility;
- New office and training facility.

At the time of writing, uMhlathuze Water has called for proposals to appoint a professional services provider to increase the treatment capacity by 60 Mℓ/day.

An additional 60 Mℓ storage is required at Madlazini Reservoir and an additional 80 Mℓ at Pearce Crescent and Hillview Reservoirs.

Due to the proposal that the Nsezi WTP becomes the main supplier of potable water to the Northern Scheme (Richards Bay and surrounding areas), a new dedicated line from Nsezi WTP to Madlazini is required. The new line is estimated to be 950 Ø - 1000Ø mm ND pipe, 7700 m in length.

To supply the existing Empangeni and Western Scheme, the following upgrades to existing pipelines is proposed:

- Upgrade Nsezi WTP to Hilltop Reservoir with an additional 300 mm diameter pipeline.
- Upgrade the pipeline to Hilltop Reservoir and Pearce Reservoir with additional 350mm diameter pipeline

## 16.5.2 Projects

## (a) Lower Thukela Phase 3 – Supply to eSekhaleni

### (i) Project Description

Construction of Phase 1 of the Lower Thukela Bulk Water Supply Scheme (LTBWSS) was completed in August 2017. The Lower Thukela Bulk Water Supply Scheme supplies the town of KwaDukuza and en route communities in the KwaZulu-Natal North Coast. Phase 2 of the LTBWSS will double the treatment capacity from 55 Mℓ/day to 110 Mℓ/day and construct a pipeline to feed into a new 30 Mℓ reservoir on the outskirts of Mandini.

The Univeral Access Plan Phase 2 planning study (Umgeni Water 2016) identified the option to use the LTBWSS to supply the King Cetshwayo District Municipality and the City of uMhlathuze.

Key information on this project is summarised in **Table 16.40.**

**Table 16.40 Project information: Lower Thukela BWSS – Phase 3**

| | |
|---|---|
| **Project Components** | • 82km of 900mm diameter steel pipeline<br>• 30km of 400mm dia (estimated) Offtake pipeline and pumps to Eshowe |
| **Capacity** | 55 Mℓ/day |

### (ii) Institutional Arrangements

Umgeni Water will own, operate and maintain the infrastructure of the Lower Thukela BWSS and will sell potable water from this system to King Cetshwayo District Municipality and City of uMhlathuze. A feasibility study is required to assess the financial viability of this phase.

### (iii) Beneficiaries

The beneficiaries of this scheme will be the Eshowe WTP supply area including Gingindlovu and portions of Kwahlokohloko in King Cetshwayo District Municipality and the eSikhaleni Supply area in the City of uMhlathuze. Assuming 200 ℓ/person/day, the estimated number of beneficiaries from the anticipated capacity of 55 Mℓ/day may be 275 000 people.

### (iv) Implementation

The Lower Thukela Bulk Water Supply Scheme – Phase 1 is complete and Phase 2 is currently in the detail design stage. The Universal Access Plan identified various options to supply King Cetshwayo District Municipality and City of uMhlathuze . A feasibility study is required to access the financial viability of this phase and will be implemented if it is determined to be a preferred supply option.

The estimated total cost of Phase 3 of the project is estimated to be R3.5 billion.

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